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A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME II - PROGRAM INTEGRATION AND DATA MANAGEMENT MODULE. APPENDIX A: DATA MANAGEMENT MODULE FLOW CHARTS AND FORTRAN LISTS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Three computer programs were written with the objective of predicting the structural weight of aircraft through analytical methods. The first program, the structural weight estimation program (SWEEP), is a completely integrated program including routines for airloads, loads spectra, skin temperatures, material properties, flutter stiffness requirements, fatigue life, structural sizing, and for weight estimation of each of the major aircraft structural components. The program produces first-order weight estimates

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and indicates trends when parameters are varied. Fighters, bombers, and cargo aircraft can be analyzed by the program. The program operates within 100,000 octal units on the Control Data Corporation 6600 computer. Two stand-alone programs operating within 100,000 octal units were also developed to provide optional data sources for SWEEP. These include (1) the flexible airloads program to assess the effects of flexibility on lifting surface airloads, and (2) the flutter optimization program to optimize the stiffness distribution required for lifting surface flutter prevention.

The final report is composed of 11 volumes. This volume (volume II) contains the methodology, program description, and user's information for the SWEEP control program, input data processing module, final output module, and the data management module.

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PART 2

DATA MANAGEMENT MODULE

Section I

INTRODUCTION

The primary purpose of the data management module, Overlay (2,0), is to process vehicle data required for the execution of the flutter and temperature module, Overlay (3,0), and the airloads module, Overlay (4,0). This module also serves the purpose of providing compatible design data to the other program modules. Data required for airloads derivation are dependent on total system definition. As a consequence, this module uses or calculates data which are pertinent to the weight analysis of individual structural components.

The data management module is structured so that compatible vehicle design constraints are reflected in the data development and analysis modules. This module starts with the input definitions of:

1. Structural component geometry
2. Flight profile
3. Performance requirements
4. Weight and balance goals and payload and subsystems weights

These input definitions are used to

1. Define the vehicle aerodynamic geometry.
2. Select speed-altitude profile and corresponding pressure data which are relevant to loads and flutter analysis.
3. Calculate first-order structural component weights.
4. Calculate weight distributions, balance, and inertia at different mission points.
5. Organize and store data for use by the data development and analysis modules.

The module is written in FORTRAN IV extended programming language and is structured in a single overlay within 50,000 octal core locations. This module consists of one control program, DATAIN, and 28 subroutines. Table 18 shows abbreviated descriptions of the function of these routines.

Execution of this module is dependent on user input data. A list of these variables, and their definitions are presented in Section III of this volume. Expanded explanations, user guides, and deck arrangement are presented in the User's Manual, Volume IX.

Program printed output is controlled by user specifications. The output consists of input data tables, weight and balance data, intermediate calculation arrays, and records organized for use by the data development and analysis modules. Warning and error messages are printed when erroneous or incompatible data is encountered. Program default procedure appears as part of the message.

TABLE 18. DATA MANAGEMENT MODULE SUBROUTINE LIST BY FUNCTIONAL GROUPINGS

1. Control and initialization

DATAIN	Initialize common, read input data, and call data processing routines

2. Speed-altitude profile evaluation

SPDALT	Calculate dynamic pressure, total temperature, and total and static pressure
TEMPRE	Calculate standard atmosphere properties at altitude
DSGNPR	Calculate inlet design pressures and maximum dynamic pressure

3. Vehicle geometry and coordinates

FUSGEO	Fuselage external shell geometry details
WHVGEO	Wing, horizontal tail, and vertical tail planform geometry parameters
DUCGEO	Inlet duct geometry details
NACGEO	Nacelle geometry details
NOSGEO	Forebody geometry effective for development of body lift

4. Initial weight development

QUIKIE	Structural component initial weight estimates
WEIDST	First level distribution of structure and content weight to structural components
PRTOWE	Output print of weight details

TABLE 18. DATA MANAGEMENT MODULE SUBROUTINE LIST BY FUNCTIONAL GROUPINGS (CONCL)

5. Weight distribution

WNGDST	Strip distribution of wing and contents
FUSDST	Strip distribution of fuselage structure
DSTTRI	Triangular shaped strip distribution of fuselage structure
CONDST	Strip distribution of fixed fuselage contents
DSTNOR	Strip distribution of concentrated fuselage contents
DSTTRP	Strip distribution of dispersed fuselage contents
FTOTAL	Strip distribution of expendable fuselage contents and summary of contents

6. Vehicle weight balance and inertia summary

AVDATA	Vehicle weight and balance
AVDWNG	Wing and content weight, balance, and inertia
AVDAOC	Vehicle pitch and yaw inertia summary
AVDINR	Vehicle and component weight, balance, and inertia detail organization for use by fuselage module

7. File data calculation and arrangement

DBLCNT	Criteria and geometry data arrangement for use by airloads module
DWHVQQ	Speed-altitude profile data arrangement for use by flutter and temperature module
DCCNTL	Wing, horizontal tail, and vertical tail geometry and design parameter arrangement for use by wing and empennage module
DFATMG	Wing inertia bending moments for use by airloads module for fatigue evaluation
DMAXLD	Wing, horizontal tail, and vertical tail unit inertia loads for use by airloads module
DLNDGR	Landing gear design parameters for use by landing gear module

Section II

METHODS AND FORMULATIONS

GENERAL DISCUSSION

The purpose of the data management module is to reduce and process vehicle design data and parameters in a consistent manner for use by the design data evaluation and weight analysis modules.

This module determines vehicle weight, center-of-gravity position, inertia characteristics, design speeds, design limit maneuver load factors, and configuration geometry to be used by the airloads module. The airloads module uses these data to determine the design airloads on the structural components for use in the structural weight estimation process. The airloads module also uses these data to determine wing bending moment spectra for fatigue evaluation.

Since the structural weight estimation modules are multistation analysis programs, loads are calculated at discrete structural stations. Therefore, this module also processes and transmits data to the weight estimation modules, which insures compatibility between airloads, inertia definitions, and structural geometry.

Data used to define parameters which affect airloads are also pertinent to evaluation of other design requirements. As a consequence, this module also organizes and transmits data to the different modules, which insures evaluation of a consistent set of design parameters.

Specific data calculating functions are divided into separate routines which are called by the control program DATAIN. Methods employed by the data development routines are presented in the following paragraphs. Subroutines DBLCNT, DWHVQQ, DCCNTL, and DLNDGR are service routines which organize data files for use by other program modules.

FLIGHT PROFILE AND DESIGN PRESSURES

The vehicle speed-altitude profile is evaluated for vehicle design loads, air induction system design pressures, and flutter considerations. Within this module, the speed-altitude profile is evaluated to:

1. Provide the airloads module with load evaluation flight points.

2. Provide the flutter and temperature module with:

   a. Load evaluation points for calculating structure temperature at the load conditions

   b. The limit speed envelope for determining the surface flutter design points

3. Provide the fuselage module with the limit speed envelope for local panel flutter evaluation.

4. Do initial statistical structure weight estimates.

Methods employed to develop and process the foregoing information are described herein. Routines which perform these operations are:

- SPDALT — Expand the input speed-altitude profile and calculate dynamic pressure and static inlet duct pressures

- TEMPRE — Calculate standard atmosphere temperature and pressure

- DSGNPR — Calculate inlet duct hammershock pressures and scan for maximum duct pressures and dynamic pressure

- QUIKIE — Use duct pressure and dynamic pressure data to calculate initial estimate of structure weight

- AVDINR, DWHVQQ, DBLCNT — Store profile data on mass storage files for use in the flutter and temperature, airloads, and fuselage modules

- DLNDGR — Calculate stall speed at maximum design weight with flaps down, and save speeds for use in the landing gear module

SPEED-ALTITUDE PROFILE

Input speed-altitude profile data consist of five points on both the level-flight maximum speed envelope, M_H, and the limit speed envelope, M_L, starting at sea level and extending to maximum altitude. Points on the M_L profile are defined relative to the M_H profile. Data type and its use in the program are as follows:

Input Data Defining M_L	Description
0.0	M_L equal to M_H
$>0; <1.0$	Decimal to be added to M_H
>1.0	Multiplier of M_H
<0.0	Fraction of M_H to be added to M_H

This data set is expanded to define nine points by interpolating between the input points. Intermediate points are taken at altitudes midway between input altitudes, corresponding dynamic pressure is obtained by interpolation, and speed is then calculated to be compatible with the dynamic pressure and altitude.

For variable-sweep wing vehicles, level flight maximum speed-altitude profile with the wing in the forward position is defined at three points. These data points are transferred to mass storage file records in subroutines DWHVQQ and DBLCNT for use in evaluating wing flutter and vehicle airloads.

In addition to the maximum flight envelope, stall speeds at landing design weight (LDW) with flaps extended and at maximum design weight (MDW) with flaps retracted are defined in the input data set. These points are used to evaluate vehicle airloads and landing gear loads. These stall speeds are transferred to mass storage file in subroutine AVDATA for use by the airloads module. Subroutine DLNDGR calculates 120 percent of stall speed with flaps extended at both LDW and MDW and stores the data on mass storage file for use by the landing gear module.

Figure 16 shows all of the speed-altitude profile points used in SWEEP. Table 19 shows the matrix of profile points versus user program modules. Methods used to calculate atmospheric properties, dynamic pressure, and inlet duct pressures are discussed in the following paragraphs.

Ambient Temperature and Altitude

U.S. standard atmosphere temperature, T_O, and pressure, P_O, are calculated in subroutine TEMPRE by curve fit equation for different altitude ranges.[1]

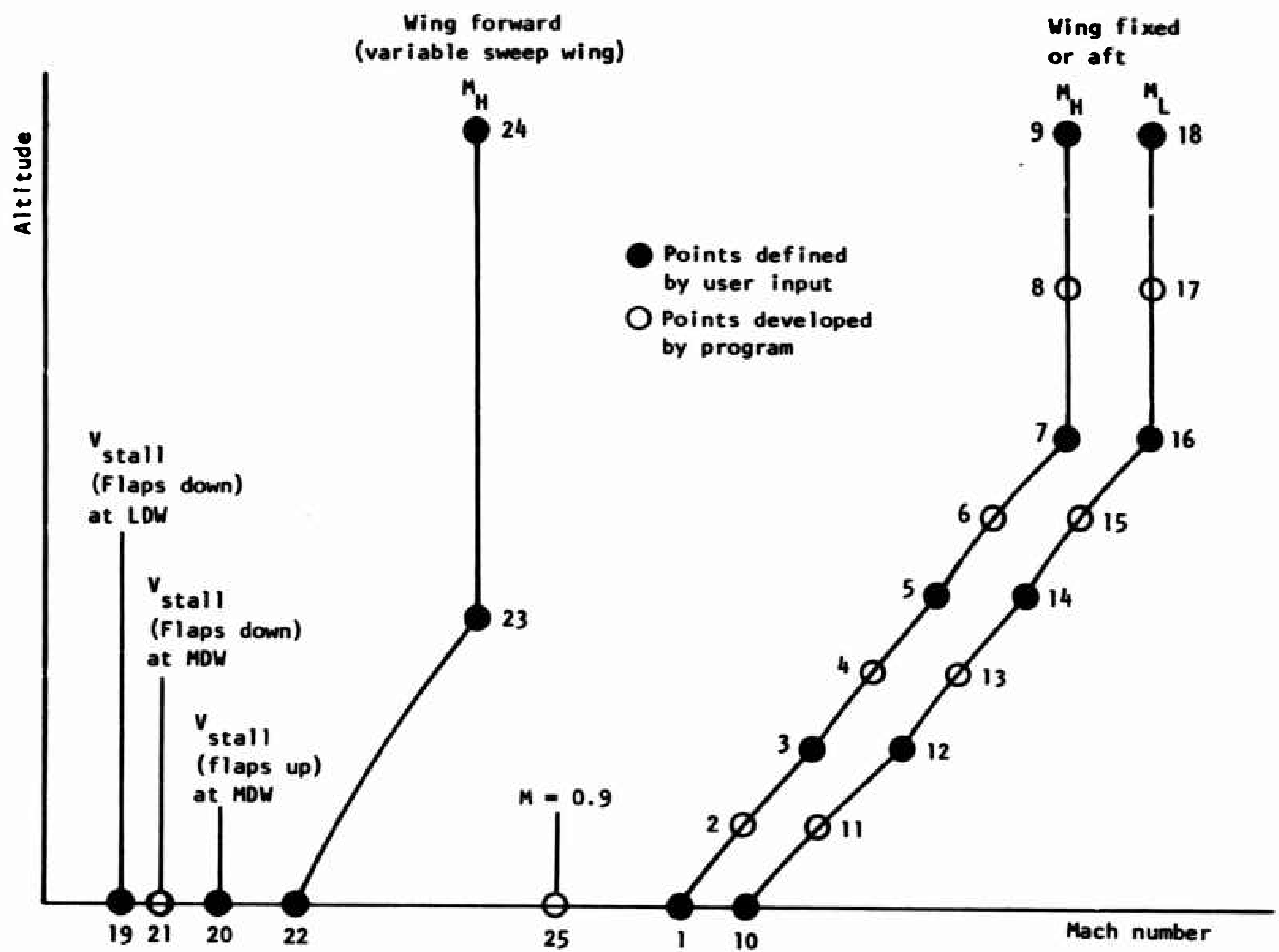


Figure 16. Speed-altitude profile points.

TABLE 19. USAGE MATRIX OF SPEED-ALTITUDE PROFILE POINTS

Speed-Altitude Profile Point Number \ Using Modules	Data Management	Flutter and Temperature	Airloads	Wing and Empennage	Landing Gear	Air Induction System	Fuselage	Output
1	U, T	U	U, T			U	U	
2	C, U					C, U		
3	U					U		
4	C, U					C, U		
5	U, T	U	U, T			U	U	
6	C, U					C, U		
7	U, T	U	U, T			U	U	
8	C, U					C, U		
9	U					U		
10	U, T	U	U, T	U		U	U	
11	C, U, T	U		U		C, U	U	
12	U, T	U		U		U	U	
13	C, U, T	U		U		C, U	U	
14	U, T	U	U, T	U		U	U	
15	C, U, T	U		U		C, U	U	

TABLE 19. USAGE MATRIX OF SPEED-ALTITUDE PROFILE POINTS (CONCL)

Speed-Altitude Profile Point Number / Using Modules	Data Management	Flutter and Temperature	Airloads	Wing and Empennage	Landing Gear	Air Induction System	Fuselage	Output
16	U, T	U	U, T	U		U	U	
17	C, U, T	U		U		C, U	U	
18	U, T	U		U		U	U	
19	T		U, T		U		U	U
20	T	U	U, T				U	
21	C, T				U			
22	T	U	U, T	U			U	
23	T	U	U, T	U			U	
24	T	U		U				
25		C, U	C, U, T				U	

NOTE C denotes calculated within modules.
U denotes used within module.
T denotes transferred to mass storage files for use by other modules.

Between 0 and 36,089.24 feet,

$$T_o = 518.67 - 3.56616\ (ALT) \tag{1}$$

$$P_o = 2116.22\ [1.0 - 0.00687559\ (ALT)]^{5.25591} \tag{2}$$

where

T_o = ambient temperature, ° R

P_o = ambient pressure, lb/ft^2

ALT = geopotential altitude, ft/1,000

Between 36,089.24 and 65,616.88 feet,

$$T_o = 389.97 \tag{3}$$

$$P_o = \frac{472.68}{e^{\left(\frac{ALT-36.08924}{20.80556}\right)}} \tag{4}$$

Between 65,616.88 and 104,986.9 feet,

$$T_o = 389.97 + 0.548641\ (ALT-65.61688) \tag{5}$$

$$P_o = 114.345 \left[1.0 + \frac{0.548641\ (ALT-65.61688)}{389.97}\right]^{-34.1634} \tag{6}$$

Between 104,986.9 and 154,199.5 feet,

$$T_o = 411.57 + 1.53619\ (ALT-104.9869) \tag{7}$$

$$P_o = 18.131 \left[1.0 + \frac{1.53619\ (ALT-104.9869)}{411.57}\right]^{-12.2012} \tag{8}$$

Should the altitude exceed 154,199.5 feet, a warning message is printed, equation 7 is used to calculate T_o, and equation 8 is used to calculate P_o.

Dynamic Pressure

Dynamic pressure is calculated in subroutine SPDALT by using local temperature and pressure, equation fit approximation of the acceleration of gravity, and assuming constant specific heat ratio.

$$g = 32.17405 - 0.00000304\ ALT \tag{9}$$

$$\rho = \frac{P_o}{RT_o} \tag{10}$$

$$C_s = \sqrt{\gamma g R T_o} \tag{11}$$

$$q = \frac{\rho}{2g} (M_o\ C_s)^2 \tag{12}$$

where

- g = acceleration of gravity, ft/sec^2
- ρ = density of air, lb/ft^3
- R = gas constant, 53.3 ft-lb/lb/° R
- γ = ratio of specific heats, 1.4
- C_s = speed of sound, ft/sec
- M_o = vehicle mach number
- q = dynamic pressure, lb/ft^2

Inlet Duct Pressures and Temperatures

Inlet duct static pressures and temperatures are calculated in subroutine SPDALT, and hammershock pressures are calculated in subroutine DSGNPR. Isentropic compressible flow equations and empirical formulations for pressure recovery ratio, airflow, and attenuation are used to calculate the required data. The subscript, (1), is used to denote inlet throat station, and the subscript, (2), to denote engine front face station in the discussions that follow.

Total Temperature and Pressure

Total temperature, T_{T2}, and total pressure, P_{T2}, are calculated by equations 13 and 14.

$$T_{T2} = T_o \left(1 + \frac{\gamma-1}{2} M_o^2\right) \tag{13}$$

$$P_{T2} = (P_{T2}/P_{T0})\, P_o \left(1 + \frac{\gamma-1}{2} M_o^2\right)^{\frac{\gamma}{\gamma-1}} \tag{14}$$

where

P_{T2}/P_{T0} = inlet pressure recovery ratio

Pressure recovery ratio may be user input. However, if it is not available, equation 15 from reference 2 is used to calculate recovery ratio for supersonic speeds. For subsonic speeds, recovery ratio is assumed to be 1.0.

$$P_{T2}/P_{T0} = 1.0 - 0.075\,(M_o - 1.0)^{1.35} \tag{15}$$

Static Pressure

Static pressure at the engine face, P_2, is calculated by equation 16.

$$P_2 = \frac{P_{T2}}{\left(1 + \frac{\gamma-1}{2} M_2\right)^{\frac{\gamma}{\gamma-1}}} \tag{16}$$

where

M_2 = mach number of air at engine face

Mach number of the air at the engine face may be user input or, if not available, is defined by the following approximations:

$M_2 = 0.3$ when $M_o > 1.0$

$M_2 = 0.5$ when $M_o \leq 1.0$

Static pressure at the inlet throat, P_1, is obtained from the curve of the ratio of static pressure to free-stream total pressure versus mach number (Figure 17). This ratio, which is the pressure ratio behind the normal shock, is calculated by equation 17.

$$P_1/P_{T0} = 0.8 - 0.05M \tag{17}$$

Hammershock Pressure

Hammershock pressure in the inlet system is caused by engine stall and consequent airflow cutoff. This pressure is dependent on internal engine geometry. Hard stall of turbojet engines creates hammershock pressure ratios, P_{HS2}/P_2, of about 2, which indicates 100-percent inlet flow cutoff. In the case of fan engines, most of the stalls occur in the high-pressure compressor. As the hammershock pulse emerges from the compressor, the fan bypass ducting provides a path through which the pulse is vented; step change in fan back pressure is reduced, and pressure rise in the inlet duct is correspondingly lower. As the bypass ratio of the fan is increased, the relative air mass involved with compressor stall decreases, fan air bypass duct volume increases, and pressures forward of the fan are lower. Plots of hammershock pressure ratio versus total temperature, T_{T2}, for turbojet and fan engines are shown in Figure 18. These curves are based on corrected airflow, $f(M_2)$, versus total temperature data for typical engines, and hammershock pressure ratio data from reference 3. Equations 18, 19, 20, and 21 approximate these curves and are used to calculate the pressure ratio for different engines.

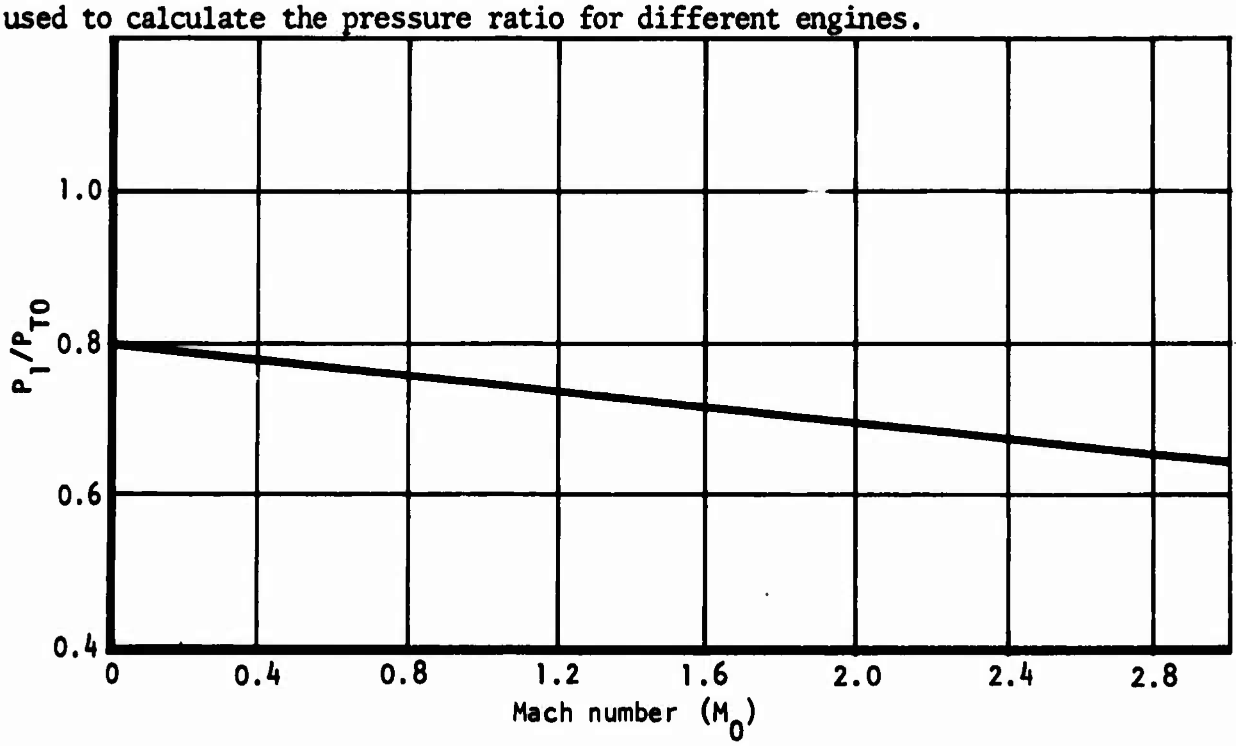


Figure 17. Throat static pressure ratio.

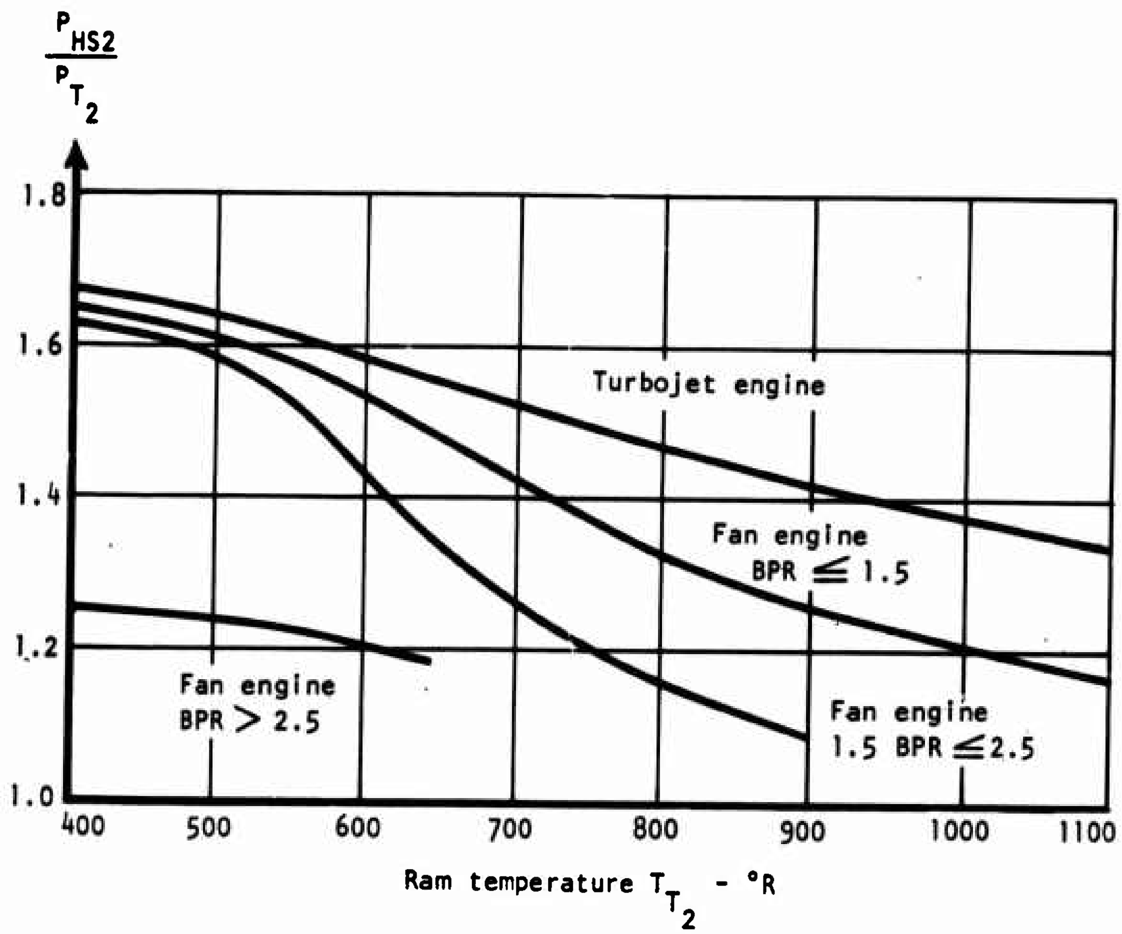


Figure 18. Hammershock pressure ratio.

Turbojet

$$P_{HS2}/P_{T2} = 1.019056 - 0.0289156\left(\frac{T_{T2}}{400}\right) + 1.350112\left(\frac{400}{T_{T2}}\right)$$

$$- 0.664319\left(\frac{400}{T_{T2}}\right)^2 \quad . \tag{18}$$

Fan engine: BPR ≤ 1.5

$$P_{HS2}/P_{T2} = -0.00602627 + 0.080725\left(\frac{T_{T2}}{400}\right) + 3.16503\left(\frac{400}{T_{T2}}\right)$$

$$- 1.588524\left(\frac{400}{T_{T2}}\right)^2 \tag{19}$$

Fan engine: $1.5 < \text{BPR} \leq 2.5$

$$P_{HS2}/P_{T2} = -0.770476 + 0.1482515\left(\frac{T_{T2}}{400}\right) + 4.371758\left(\frac{400}{T_{T2}}\right)$$

$$- 2.114969\left(\frac{400}{T_{T2}}\right)^2 \tag{20}$$

Fan engine: $2.5 < \text{BPR}$

$$P_{HS2}/P_{T2} = 1.538116 - 0.3029697\left(\frac{T_{T2}}{400}\right) + 0.4872335\left(\frac{400}{T_{T2}}\right)$$

$$- 0.4653126\left(\frac{400}{T_{T2}}\right)^2 \tag{21}$$

As the hammershock moves forward in the inlet duct, experimental trends show an attenuation behind the shock, due to boundary layer-shock interaction, and bleed off into boundary layer control plenums and bypass exits. Figure 19 shows a curve approximating the attenuation between engine face and inlet throat. Equation 22 is the approximation of this curve that is used in the program.

$$P_{HS1}/P_{HS2} = 0.984 - 0.0074\ M_o - 0.0263\ M_o^2 \tag{22}$$

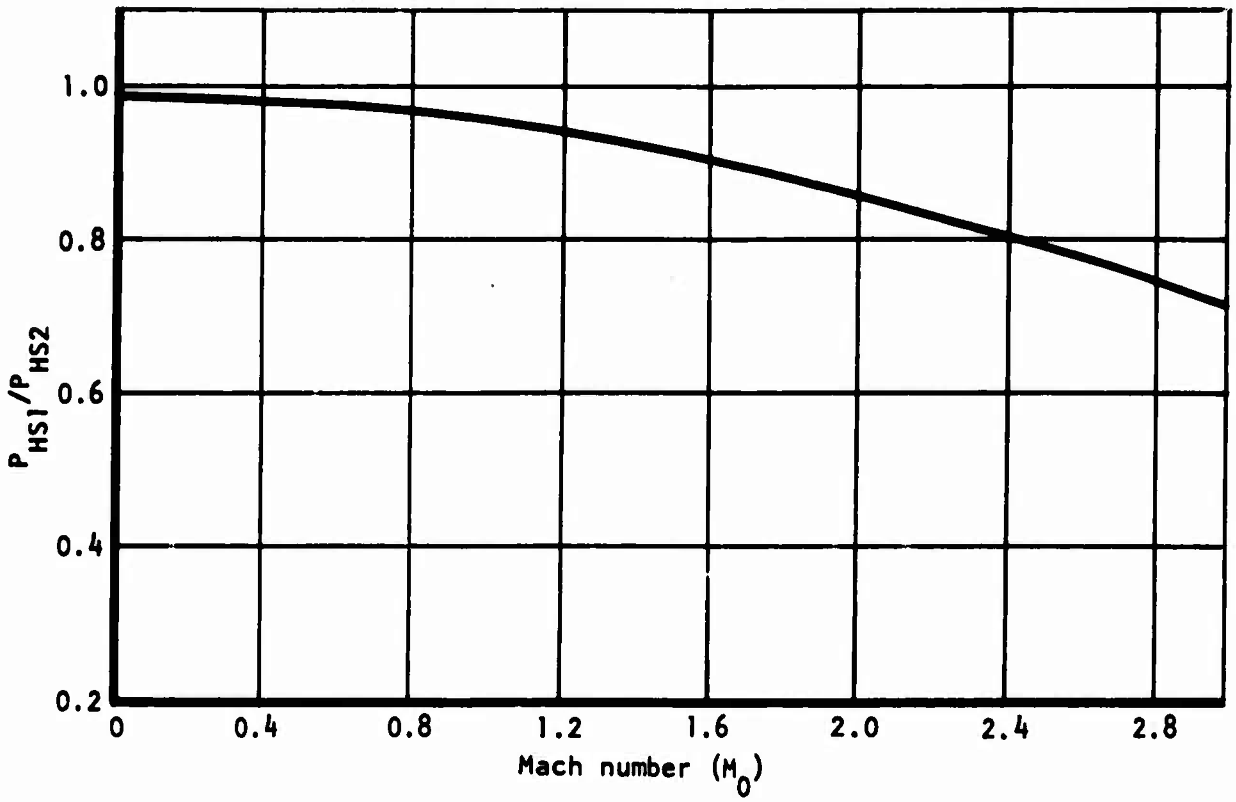


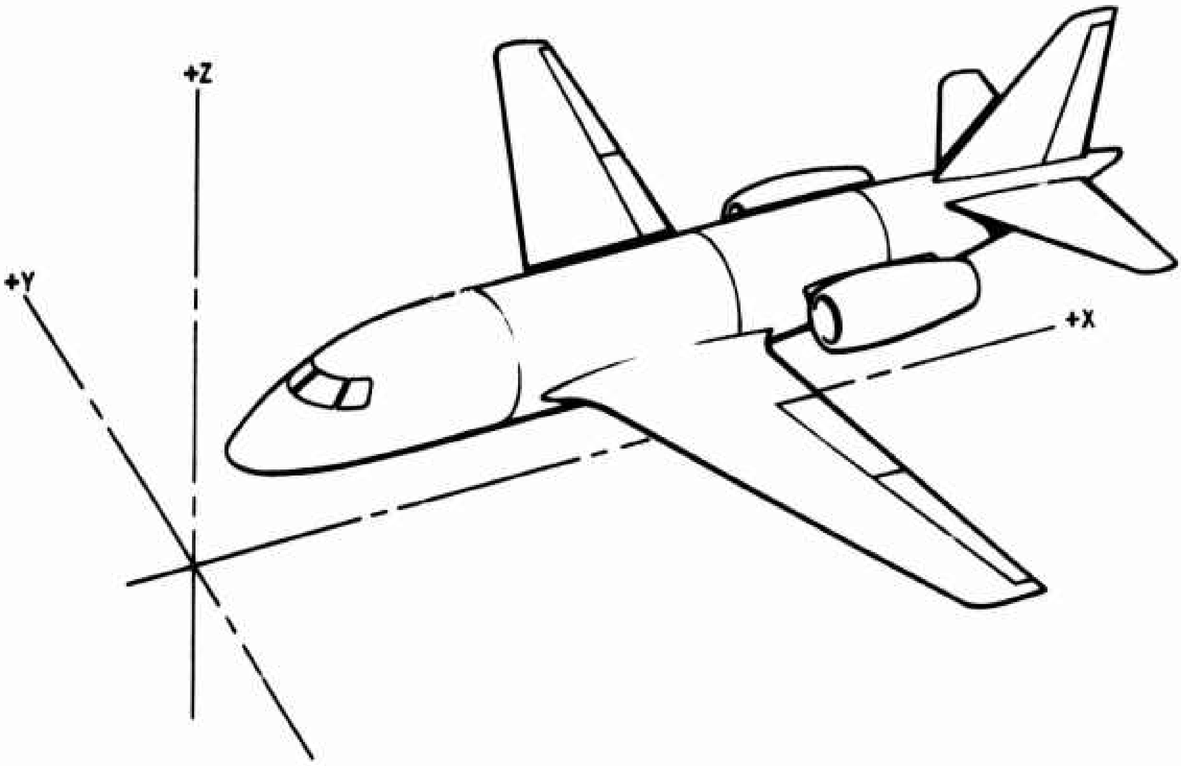
Figure 19. Hammershock attenuation at throat.

Inlet Duct Design Pressures

Maximum static pressure, hammershock gage pressure, and hammershock absolute pressures are determined by scaning the pressure data at each of the speed-altitude profile points. These data are used in subroutine QUIKIE to arrive at initial air induction system component weight estimates.

VEHICLE GEOMETRY

Vehicle geometry is a significant parameter in the various criteria analysis procedures which have been integrated in this program. The primary function of the geometry calculating routines in this module is to provide data that are consistent within the program structure. The following stability axis definitions are used to define the vehicle coordinate system.



This system provides a mathematical reference for the relative location of structural components. Subroutines FUSGEO, WHVGEO, DUCGEO, NACGEO, and NOSGEO calculate geometric data for use in making initial weight estimates, weight distributions, and inertia calculations, and for use by the airloads module. Discussions that follow describe methods employed in these geometry routines.

FUSELAGE GEOMETRY

External fuselage shell geometry details are calculated in subroutine FUSGEO. Data input to this routine and the methods employed are identical to procedures used in the fuselage weight estimating module. In order to minimize user input requirements, the programmed approach is based on a generalized approximation of shell shapes.

External shell geometry is defined at 10 longitudinal locations on the fuselage. These input geometry cuts are at the nose, tail, and eight intermediate stations. Sharp geometric changes, such as occur at the start of duct inlets, are described by cuts immediately forward and aft of the shape transition.

Either of two input formats may be used to define the geometry at the geometry cuts (XI):

1. Width (WI), depth (DI), vertical centroid (ZI), and perimeter (PI)

2. Width (WI), depth (DI), vertical centroid (ZI), and perimeter correlation factor (Kc)

If the perimeter is not readily available, perimeter correction factor (Kc) may be used to describe the shape. Figure 20 depicts the significance of Kc. The family of rounded rectangle shapes is defined within the region bounded by the curves for rectangular, vertical oval, and horizontal oval shapes. The intersection point of the curves for horizontal and vertical ovals represents a circular cross section. The perimeter is defined by the relationship:

$$PI = Kc \frac{\pi}{2} (DI + WI) \tag{23}$$

where

Kc = 1.0 indicates a circular shape

Kc = 1.273 indicates a rectangular shape

Shell structural sizing is evaluated at a maximum of 19 synthesis cuts. These synthesis cuts are taken along the longitudinal axis and are located by the user to provide load and geometry sensitivity.

Depth (D), width (W), perimeter (PER), and vertical centroid (ZO) at the synthesis cuts (XO) are obtained by interpolating between the input geometry cuts. Interpolated data are then used to obtain the other shape parameters. A sketch of the general shape and parameters at a synthesis cut follows.

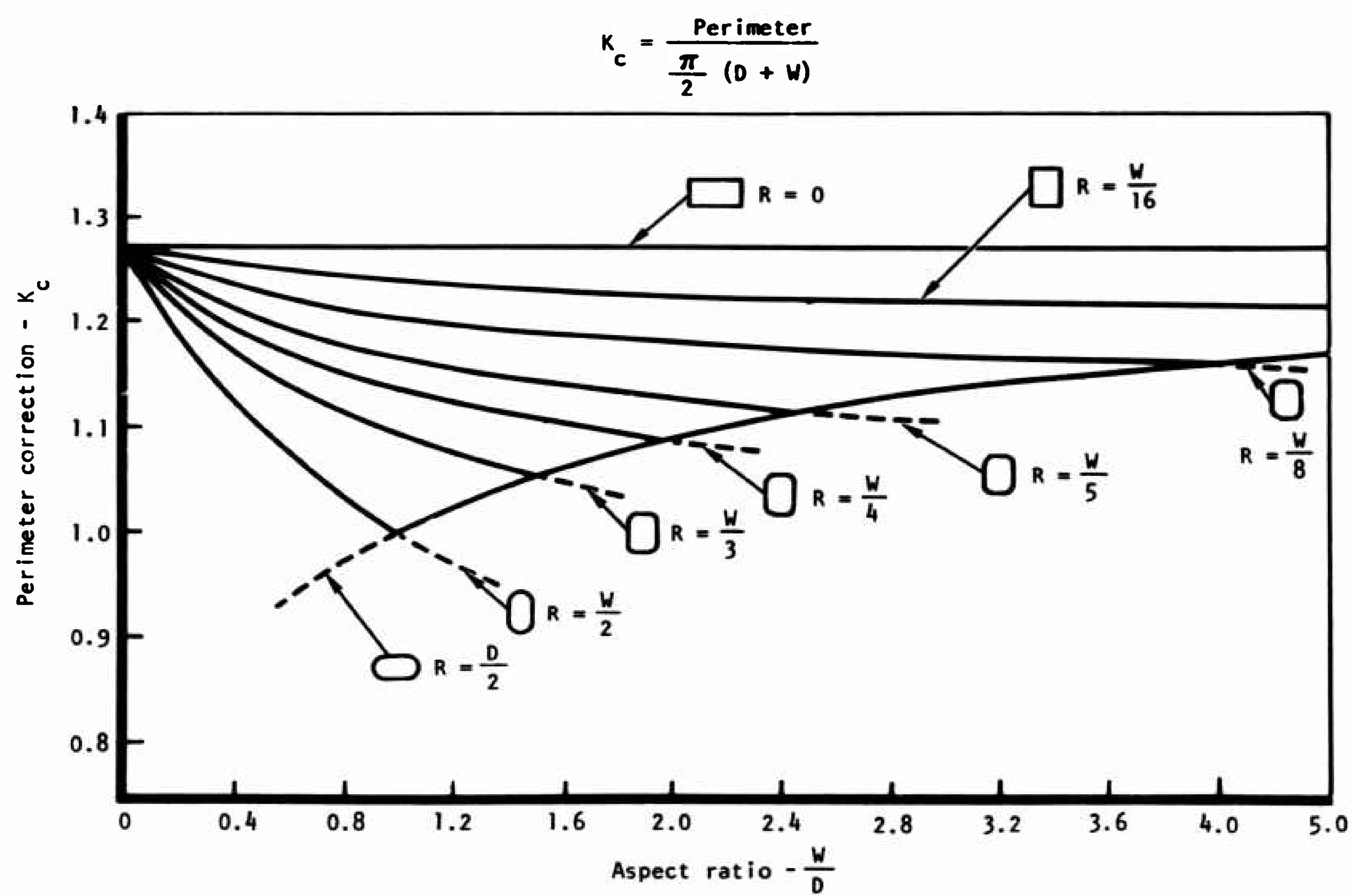
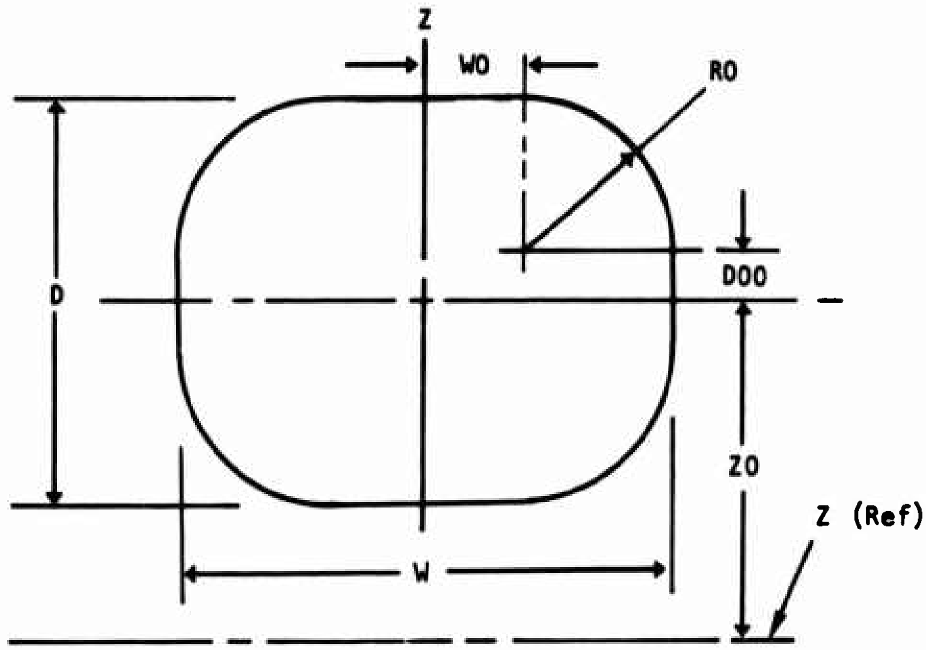


Figure 20. Programmed shapes and correction factors.



The perimeter is defined as:

$$PER = 4(DOO + WO) + 2\pi RO \tag{24}$$

and

$$WO = (W - 2RO)/2 \tag{25}$$

$$DOO = (D - 2RO)/2 \tag{26}$$

substituting and solving for the corner radius:

$$RO = \frac{2D + 2W - PER}{8 - 2\pi} \tag{27}$$

If the input parameters result in RO<0 or 2RO>W or D, the perimeter is maintained and the parameters RO, DOO, and WO are adjusted by a factor K.

If $RO<0$, the shape is adjusted to represents a rectangle in the following manner:

$$RO = 0 \tag{28}$$

$$PER = K(2D + 2W) \tag{29}$$

$$K = \frac{PER}{2D + 2W} \tag{30}$$

If $2RO > W$ or D, the shape is adjusted to represent a horizontal or vertical oval in the following manner:

$$RO = \text{minimum of } W/2 \text{ or } D/2 \tag{31}$$

$$X = \text{maximum of } W \text{ or } D \tag{32}$$

$$PER = K(2\pi RO + 2(X - 2RO)) \tag{33}$$

$$K = \frac{PER}{2\pi RO + 2(X - 2RO)} \tag{34}$$

Then the adjusted values for DOO, WO, and RO are:

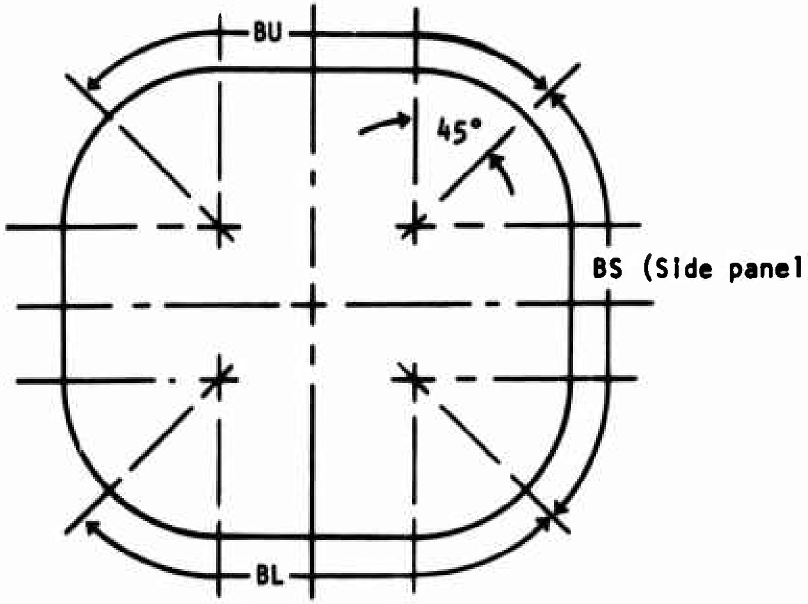
$$WO = K(W - 2RO)/2 \tag{35}$$

$$DOO = K(D - 2RO)/2 \tag{36}$$

$$RO = K(RO) \tag{37}$$

Should the geometry require adjustment by "K," a warning message is printed to indicate the amount of adjustment made to the depth and width at the section.

Structural sizing is accomplished for four shell sectors representing the upper, lower, and two sides. A 45-degree angle is used to define the limits of these sectors.



The peripheral length of the cover elements in these sectors are:

$$BU = BL = 2WO + \frac{\pi}{2} RO \tag{38}$$

$$BS = 2DOO + \frac{\pi}{2} RO \tag{39}$$

Curvature of the panels in the different sectors are also pertinent to the analytical procedures. The radius of curvature for circular fuselages is clearly defined. However, in the case of noncircular shapes, there is no true radius of curvature. Therefore, a nominal (weighted average) radius of curvature is defined in the following manner:

$$RCS^2 = [RCS - RO(1 - \cos 45°)]^2 + (RO \sin 45° + DOO)^2 \tag{40}$$

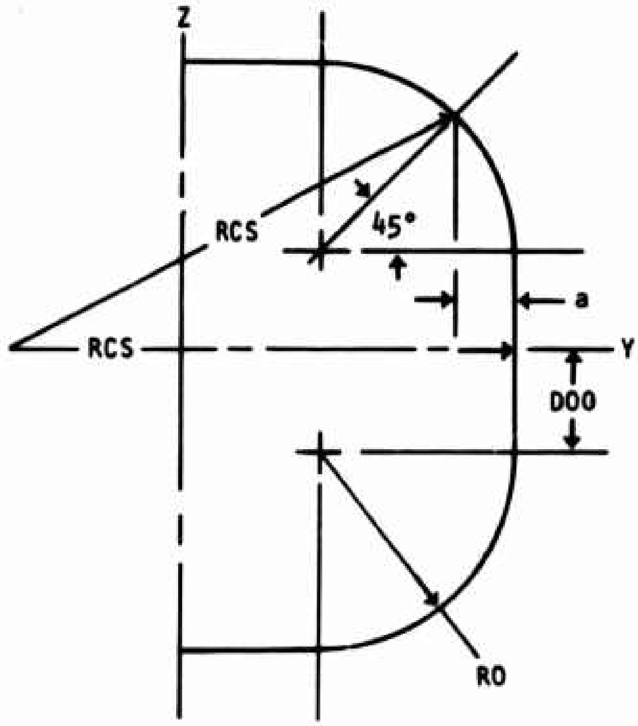
let

$$a = RO\ (1 - \cos 45°) \tag{41}$$

$$b = RO \sin 45° + DOO \tag{42}$$

then

$$RCS = \frac{a^2 + b^2}{2a} \tag{43}$$



The nominal radius of curvature for the upper (RCU) and lower (RCL) sectors are calculated in the same manner. If the corner radius is less than 2 inches, the nominal radius of curvature is assumed to be infinite. A value of zero for curvature is used to designate the flat panel.

Segment geometric data are calculated from the cut data. The subscript n is used in the discussion that follows to denote the shell segment bounded by cuts j-1 and j.

Segment length (DELX) is determined by taking the difference between adjacent cuts. Surface area and volume are calculated by idealizing the segment as a truncated cone.

The radius ($\bar{R}$) of the end of the cone is:

$$\bar{R}_j = \frac{PER_j}{2\pi} \qquad (44)$$

then the surface area (SF) is

$$SF_n = \pi(\bar{R}_j + \bar{R}_{j-1}) \sqrt{DELX_n^2 + (\bar{R}_j - \bar{R}_{j-1})^2} \tag{45}$$

The cross-section area (A) at any cut is:

$$A_j = \pi RO_j^2 + 4DOO_j(WO_j + RO_j) + 4WO_j\ RO_j \tag{46}$$

and the volume (VOL) is:

$$VOL_n = \frac{DELX_n}{3}\left[A_j + A_{j-1} + (A_j\ A_{j-1})^{1/2}\right] \tag{47}$$

The surface area and volume for the nose and tail segments are calculated in the same manner, except the input nose and tail station geometry are used to define one end of the truncated cone. Area and volume of segments less than 2 inches in length, indicating sharp geometric transitions are calculated by using geometry data at the aft end of the segment.

Intermediate segment centroids (XBAR) are assumed to be midway between the bounding cuts. The centroid of the nose and tail segments are calculated for the truncated cone. The nose segment centroid calculation is shown:

$$XBAR_1 = XO_1 - \frac{DELX_1}{3}\frac{(2\bar{R}_1 + \bar{R}_2)}{(\bar{R}_1 + \bar{R}_2)} \tag{48}$$

Pitch (UIY), roll (UIX), and yaw (UIZ) unit inertia calculations are based on the following assumptions:

1. The weight of fuselage and contents are uniformly distributed within the segment; i.e., a homogeneous distribution.

2. The center of gravity of the weights is at the centroid of the segment.

These unit inertias, when multiplied by the distributed weights, define the local weight moment of inertia within the segment.

Inertia about the centroid per pound of weight is defined as a function of the average segment geometry as follows:

where

$$D'_n = (DOO_j + DOO_{j-1})/2 \tag{49}$$

$$W'_n = (WO_j + WO_{j-1})/2 \tag{50}$$

$$R'_n = (RO_j + RO_{j-1})/2 \tag{51}$$

$$A_n = \pi R'^2_n + 4D'_n\,(W'_n + R'_n) + 4W'_n\,R'_n \tag{52}$$

$$UIY_n = \frac{4/3\,W'_n\,(D'_n + R'_n)^3 + 4/3\,R'_n D'^3_n + \pi/4\,R'^4_n + \pi R'^2_n\,D'^2_n}{A_n} + DELX^2_n/12 \tag{53}$$

$$UIZ_n = \frac{4/3\,D'_n\,(W'_n + R'_n)^3 + 4/3\,R'_n W'^3_n + \pi/4\,R'^4_n + \pi R'^2_n\,W'^2_n}{A_n} + DELX^2_n/12 \tag{54}$$

$$UIX_n = \left[4/3\,W'_n\,(D'_n + R'_n)^3 + 4/3\,D'_n\,(W'_n + R'_n)^3 + 4/3\,R'_n\left(D'^3_n + W'^3_n\right) + \pi/2\,R'^4_n + \pi R'^2_n\left(D'^2_n + W'^2_n\right)\right]/A_n \tag{55}$$

For segments less than 2 inches in length, unit inertia calculations are based on geometry at the aft end of the segment. For the nose and tail segments, equivalent section radius is used to calculate the inertia. The nose segment calculations are as follows:

$$UIX_1 = \frac{3\left(\bar{R}_2^5 - \bar{R}_1^5\right)}{10\left(\bar{R}_2^3 - \bar{R}_1^3\right)} \tag{56}$$

$$UIY_1 = UIZ_1 = \frac{UIX_1}{2} + \frac{27}{80}\ (XO_1 - XBAR_1)^2 \tag{57}$$

NACELLE AND AIR INDUCTION SYSTEM

Propulsion systems may be either mounted in the fuselage or mounted in nacelles. In either case, the leading edge of the inlet is located in terms of the vehicle coordinate system, and the duct and nacelle longitudinal station zero is at the inlet leading edge. Duct geometry details are calculated in subroutine DUCGEO, and nacelle geometry in subroutine NACGEO.

Duct Geometry

Duct cross-sectional geometry is defined at as many as 10 longitudinal stations, starting at the lip, (0.0), and ending at the front face of the engine. Ducts on any vehicle are assumed to be identical, such that the description of a single duct is sufficient. The presence of bifurcated inlets on most current fighters which combine into a single duct at a point forward of the engine face is defined by description of the lateral coordinate of the duct centerline relative to the nacelle centerline for podded engine concepts, or the lateral coordinate relative to the fuselage centerline on buried-engine concepts. A lateral nonzero coordinate defines the presence of two ducts per nacelle or fuselage, while zero indicates the presence of a single duct. Thus, if synthesis cuts are spaced close together at the juncture, one defining geometry immediately forward and the other geometry immediately aft of the transition, geometry at the aft cut is used to calculate duct surface area bounded by the two cuts.

A one-dimensional leading edge is described by the single dimension; the next synthesis cut describes the first section at which the duct is continuous. Detail description of sectional geometry is identical to that used to define fuselage contour geometry. Calculations are made to determine perimeter and shape parameters at the cuts, and length, longitudinal centroid,

and surface area for segments bounded by cuts. One-dimensional leading edge surface area and centroid are determined from geometric data at the first two cuts. For vertical leading edges there are two possibilities; a third case, although improbable, is also programmed.

Case where lateral coordinates at stations 1 and 2 are both positive:

$$SFD_1 = DLXD_1 \; (D_1 + BSD_2 + BUD_2 + BLD_2) \tag{58}$$

where

SFD_1 = duct lip surface area

$DLXD_1$ = leading edge segment length

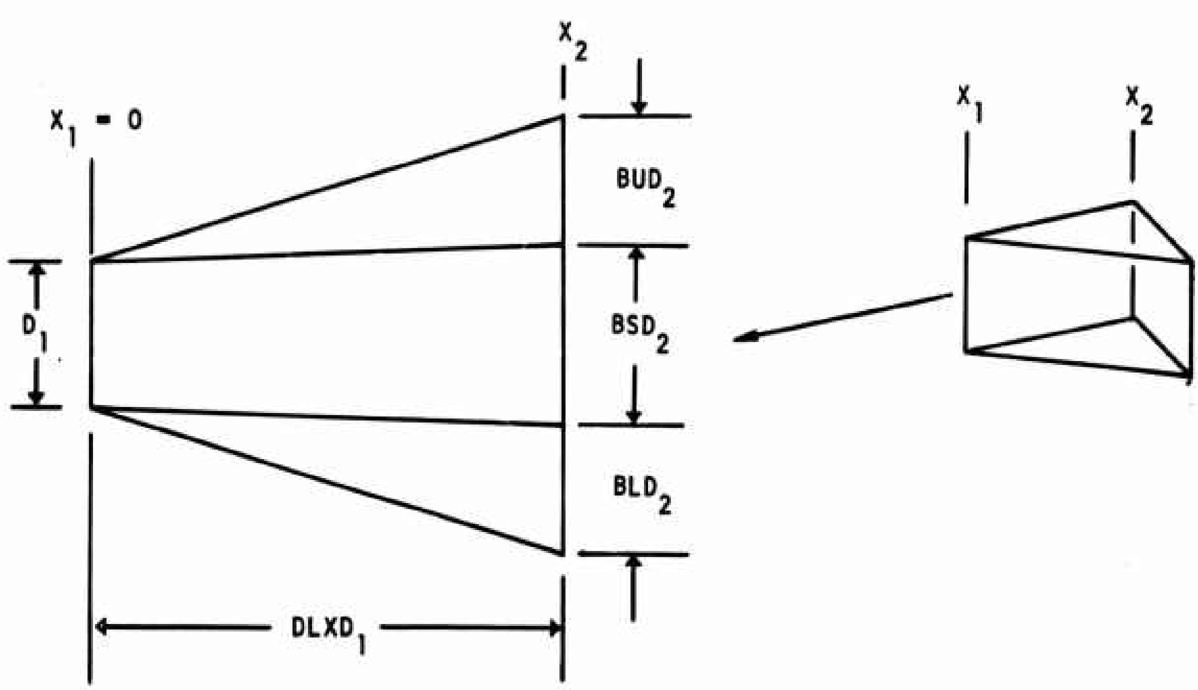
D_1 = depth at station 1

BSD_2 = peripheral length of duct side sector at station 2

BUD_2 = peripheral length of duct upper sector at station 2

BLD_2 = peripheral length of duct lower sector at station 2

The foregoing calculation accounts for two separated inlets as would occur for fuselage-buried engine concepts with side inlets. A flat pattern representation of one of these inlet surfaces follows.



Case where lateral coordinate at station 1 is zero and at station 2 is positive:

$$SFD_1 = DLXD_1 \left(\frac{D_1 + BSD_2}{2} + BUD_2 + BLD_2 \right) \tag{59}$$

Equation 59 represents the case where there are two inlets per nacelle or, on fuselage-buried engine concepts, two inlets with a common vertical splitter.

Case where lateral coordinate at stations 1 and 2 are both zero:

$$SFD_1 = \frac{DLXD_1}{2} \left(D_1 + BSD_2 + BUD_2 + BLD_2 \right) \tag{60}$$

For horizontal leading edges, there are two possibilities. Case where the lateral coordinate at station 2 is zero is calculated by equation 61. This situation represents a single inlet per nacelle or fuselage.

$$SFD_1 = \frac{DLXD_1}{2} \left(W_1 + BUD_2 + 2\ BSD_2 \right) \tag{61}$$

where

W_1 = width of inlet lip at station 1

The case where the lateral coordinate at station 2 is positive represents two inlets per nacelle or fuselage and is calculated by equation 62.

$$SFD_1 = DLXD_1 \left(W_1 + BUD_2 + \frac{3}{2}\ BSD_2 \right) \tag{62}$$

Nacelle Geometry

Nacelle cross-sectional geometry is defined at as many as 10 longitudinal stations, starting at the inlet lip, station zero, and ending at the last full section of the nacelle. One-dimensional leading edges are defined as follows:

1. Horizontal leading edge - input zero for perimeter and actual width of leading edge

2. Wedge leading edges as would occur on nacelles with two inlet ducts with vertical leading edges - input zero for perimeter and depth at leading edge

Detail description of continuous section geometry and contour calculations is identical to that used to define fuselage geometry. Surface area for one-dimensional leading edge segments are calculated by equation 63 for horizontal leading edges and by equation 64 for wedge leading edges.

$$SFN_1 = \frac{DLXN_1}{2} (W_1 + BUN_2 + 2\ BSN_2) \tag{63}$$

$$SFN_1 = \frac{DLXN_1}{2} (BUN_2 + BLN_2) \tag{64}$$

where

SFN_1 = nacelle leading edge segment surface area

$DLXN_2$ = leading edge segment length

W_1 = width of nacelle lip at station 1

BUN_2 = peripheral length of nacelle upper sector at station 2

BSN_2 = peripheral length of nacelle side sector at station 2

BLN_2 = peripheral length of nacelle lower sector at station 2

Unit inertia for continuous segments are calculated in the same manner as used for the fuselage. Equations 65 through 67 are used to calculate unit inertias for vertical wedge-type leading edge segments.

$$UIXN_1 = \left(\frac{W_2^2}{24} + \frac{D_2^2}{4}\right) \tag{65}$$

$$UIYN_1 = \left(\frac{DLXN_1^2}{18} + \frac{D_2^2}{4}\right) \tag{66}$$

$$UIZN_1 = \left(\frac{W_2^2}{24} + \frac{DLXN_1^2}{18}\right) \tag{67}$$

Equations 68 through 70 are used to calculate unit inertias for horizontal lip-type leading edge segments.

$$UIXN_1 = \left\{\left(\frac{D_2^2}{18} + \frac{W_2^2}{4}\right)(BSN_2) + \left(\frac{W_2^2}{12} + \frac{D_2^2}{9}\right)(BUN_2)\right\} DLXN_1/SFN_1 \tag{68}$$

$$UIYN_1 = \left\{ \left(\frac{D_2^2}{18} + \frac{DLXN_1^2}{18} \right) (BSN_2) + \left(\frac{DLXN_1^2}{9} + \frac{D_2^2}{9} \right) (BUN_2) \right\} DLXN_1/SFN_1 \tag{69}$$

$$UIZN_1 = \left\{ \left(\frac{W_2^2}{4} + \frac{DLXN_1^2}{18} \right) (BSN_2) + \left(\frac{W_2^2}{12} + \frac{DLXN_1^2}{9} \right) (BUN_2) \right\} DLXN_1/SFN_1 \tag{70}$$

WING AND EMPENNAGE GEOMETRY

Wing, horizontal tail, and vertical tail geometry data are input for theoretical trapezoidal planforms. Subroutine WHVGEO uses these data to develop additional geometry required in this module and by other program modules which evaluate these surfaces. Methods used to calculate additional geometry for fixed wings, variable-sweep wings, horizontal tails, and vertical tails are discussed in the following paragraphs.

Fixed-Wing Geometry

Minimum input descriptions for a fixed wing consist of the following data:

S = wing planform area, ft^2

AR = aspect ratio

λ_W = taper ratio

Λ_{REF} = sweep of reference axis, deg

$(X/C)_{REF}$ = reference axis location in terms of fraction of total chord

X_{LE} = longitudinal station of wing leading edge apex in vehicle reference system

or

$X_{\bar{C}/4}$ = longitudinal station of quarter chord at mean aerodynamic chord (MAC)

Z = water plane of airfoil neutral axis at vehicle centerline, in.

$b_1/2$ = buttock line of wing to fuselage tie, side of body station, in.

$(X/C)_{EA}$ = structural elastic axis location in terms of fraction of total chord

Wing span (b), root chord (C_R), tip chord (C_T), and mean aerodynamic chord (MAC) are calculated by equations 71 through 74.

$$b = \sqrt{AR\ S}/12, \text{ in.} \tag{71}$$

$$C_R = \left[\frac{2S}{b(1+\lambda)}\right] 144, \text{ in.} \tag{72}$$

$$C_T = \lambda\ C_R, \text{ in.} \tag{73}$$

$$MAC = \frac{2}{3}\left(C_R + C_T - \frac{C_R C_T}{C_R + C_T}\right) \tag{74}$$

Sweep of the leading edge, trailing edge, and elastic axis are calculated by equations 75 through 77, respectively.

$$\tan \Lambda_{LE} = \tan \Lambda_{REF} + \frac{4}{AR}\ \frac{(1-\lambda)}{(1+\lambda)}\ \frac{X}{C}_{REF} \tag{75}$$

$$\tan \Lambda_{TE} = \tan \Lambda_{REF} + \frac{4}{AR}\ \frac{(1-\lambda)}{(1+\lambda)} \left[\left(\frac{X}{C}\right)_{REF} - 1.0\right] \tag{76}$$

$$\tan \Lambda_{EA} = \tan \Lambda_{REF} + \frac{4}{AR}\ \frac{(1-\lambda)}{(1+\lambda)} \left[\left(\frac{X}{C}\right)_{REF} - \left(\frac{X}{C}\right)_{EA}\right] \tag{77}$$

Should wing longitudinal location be defined in terms of MAC, the leading edge apex station is calculated by equation 78.

$$X_{LE} = X_{c/4} - \frac{MAC}{4} - \frac{(C_R - MAC)\ b}{2(C_R - C_T)\ \tan \Lambda_{LE}} \tag{78}$$

Wing synthesis cuts at which airloads, inertia, and, subsequently, wing sizing are to be evaluated may be input or generated by the program. If cut locations are not specified, Y-coordinates of 10 cuts are taken, starting at the side of the fuselage buttock line and extending outboard at 10-percent increments of the exposed semispan. An eleventh cut is taken at 97.5 percent of the exposed semispan.

Variable-Sweep Wing Geometry

Variable-sweep wing geometry data are input for a nominal or reference wing sweep position. Geometric input, calculations, and synthesis cut definitions are determined for this nominal position wing in the same manner as that used for a fixed wing; however, loads are calculated at two sweep positions, neither of which may be the same as the nominal sweep position. Additional input geometry data defining these load evaluation sweep positions consist of the following.

Y_P = Y-coordinate of wing pivot axis, in.

X_P = X-coordinate of wing pivot axis, in.

Λ_{FWD} = forward sweep position angle of reference chord $(X/C)_{REF}$, deg

Λ_{AFT} = aft sweep position angle of reference chord, deg

For the input nominal wing geometry, X- and Y-coordinates of 16 points on the wing are calculated as illustrated in Figure 21. Points 1 through 4 are the four corners of the wing, points 5 through 15 are the 11 synthesis stations on the elastic axis where loads are calculated, and point 16 is the intersection of the elastic axis and the tip chord. Equations 79 through 82 are used to calculate the X-coordinates of points 2, 3, 4, and 16.

$$X_2 = X_1 + C_R \tag{79}$$

$$X_3 = X_1 + \frac{b}{2} \tan \Lambda_{LE} \tag{80}$$

$$X_4 = X_2 + \frac{b}{2} \tan \Lambda_{TE} \tag{81}$$

$$X_{16} = X_1 + C_R \left(\frac{X}{C}\right)_{REF} + \frac{b}{2} \tan \Lambda_{EA} \tag{82}$$

where

$X_1 = X_{LE}$ defined either by input or by equation 78.

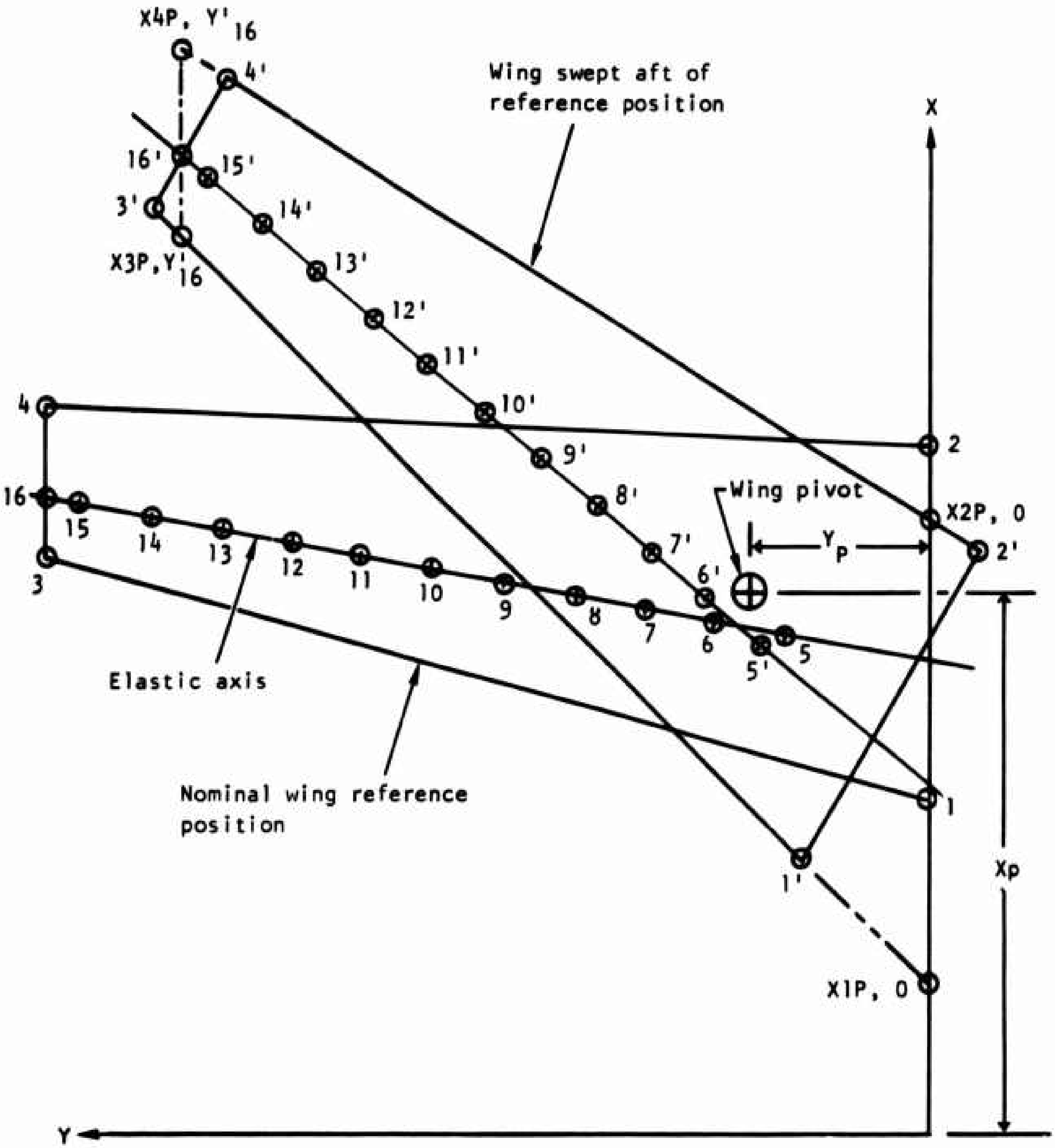


Figure 21. Variable sweep wing geometry control point locations.

The Y-coordinates of points 1 and 2 are zero, at the vehicle centerline, and Y-coordinates of points 3, 4, and 16 are at the semispan, b/2. Y-coordinates of points 5 through 15 are defined by the input data set or calculated as previously discussed. Equation 83 is used to calculate the X-coordinate of these points.

$$X_i = X_1 + C_R \left(\frac{X}{C}\right)_{EA} + Y_i \tan \Lambda_{EA} \tag{83}$$

where

i = subscript designating points 5 through 15

The foregoing nominal wing coordinate data can then be used to calculate wing geometry at the other sweep positions. Figure 21 shows an example of the wing swept aft relative to the nominal sweep position. The angle through which the wing is swept is determined from equation 84.

$$\delta\Lambda = \Lambda_{AFT} - \Lambda_{REF} \tag{84}$$

The X- and Y-coordinates of the 16 points after rotation through $\delta\Lambda$ are obtained by equations 85 and 86.

$$X_i' = (X_i - X_P) \cos \delta\Lambda + (Y_i - Y_P) \sin \delta\Lambda + X_P \tag{85}$$

$$Y_i' = (X_i - X_P) \sin \delta\Lambda + (Y_i - Y_P) \cos \delta\Lambda + Y_P \tag{86}$$

where

i = subscript, designating points 1 through 16

' = prime, designating coordinates after rotation

Coordinates of the four corners of the rotated wing are then obtained from equations 87 through 90.

$$X1P = X_1' - (X_1' - X_3') \left(\frac{Y_1'}{Y_1' - Y_3'}\right) \tag{87}$$

$$X3P = X_3' + (X_1' - X_3') \left(\frac{Y_{16}' - Y_3'}{Y_1' - Y_3'}\right) \tag{88}$$

$$X2P = X_2' - (X_2' - X_4')\left(\frac{Y_2'}{Y_2' - Y_4'}\right) \tag{89}$$

$$X4P = X_4' + (X_2' - X_4')\left(\frac{Y_{16}' - Y_4'}{Y_2' - Y_4'}\right) \tag{90}$$

Other parameters which describe the rotated wing are then calculated by using equations 91 through 99.

$$C_R' = X2P - X1P \tag{91}$$

$$C_T' = X4P - X3P \tag{92}$$

$$\lambda' = C_T'/C_R' \tag{93}$$

$$b' = 2\ Y_{16}' \tag{94}$$

$$S' = \frac{b'}{2}\ (C_R' + C_T')/144 \tag{95}$$

$$AR' = \frac{(b')^2}{144S'} \tag{96}$$

$$\left(\frac{X}{C}\right)_{EA} = \left(\frac{X_{16}' - X3P}{C_T'}\right) \tag{97}$$

$$\tan \Lambda_{LE} = \left(\frac{X3P - X1P}{Y_{16}'}\right) \tag{98}$$

$$\tan \Lambda_{EA} = \left(\frac{X_{16}' - X_5'}{Y_{16}' - Y_5'}\right) \tag{99}$$

Horizontal Tail Geometry

Horizontal tail geometry data may be input for either exposed or total surface. This option is provided for wide aft body configurations where surface geometry may be defined on preliminary design drawings in terms of exposed surface. For the case where data are defined in terms of total surface geometry, the methods and equations are identical to those used for fixed wings. When data are defined in terms of exposed geometry, total surface data are calculated by equations 100 through 108, and other calculations are then identical to those used for fixed wings.

$$b_{exp} = \sqrt{AR_{exp}\, S_{exp}}/12, \text{ in.} \tag{100}$$

$$b = 2\left(\frac{b_1}{2}\right) + b_{exp}, \text{ in.} \tag{101}$$

$$C_{R_{exp}} = \left[\frac{25}{b(1+\lambda)}\right]_{exp} 144, \text{ in.} \tag{102}$$

$$C_T = C_{R_{exp}}\, \lambda_{exp}, \text{ in.} \tag{103}$$

$$C_R = C_{T_{exp}} + \frac{b\left(C_{R_{exp}} - C_T\right)}{b_{exp}}, \text{ in.} \tag{104}$$

$$\lambda = C_T/C_R \tag{105}$$

$$S = \frac{b}{2}\,(C_T + C_R)/144, \text{ ft}^2 \tag{106}$$

$$AR = \frac{b^2}{1445} \tag{107}$$

$$X_{LE} = X_{LE_{exp}} - \frac{b_1}{2} \tan \Lambda_{LE}, \text{ in.} \tag{108}$$

where

exp = subscript designating exposed geometry data

Vertical Tail Geometry

Vertical tail geometry is input for a single theoretical exposed panel which is the geometry used in weight calculations. However, for the purpose of calculating loads, an effective surface is defined.

Should the vertical tail be on the wing, or the 50-percent root chord station be aft of the last fuselage station, methods and equations, with the exception of sweep-angle calculation, are identical to those used for fixed wings. Sweep angles are calculated by equations 109 through 111. In this case, the load reference surface and structure reference surface are identical.

$$\tan \Lambda_{LE} = \tan \Lambda_{REF} + \frac{2}{AR} \frac{(1-\lambda)}{(1+\lambda)} \left(\frac{X}{C}\right)_{REF} \tag{109}$$

$$\tan \Lambda_{TE} = \tan \Lambda_{REF} + \frac{2}{AR} \frac{(1-\lambda)}{(1+\lambda)} \left[\left(\frac{X}{C}\right)_{REF} - 1.0\right] \tag{110}$$

$$\tan \Lambda_{EA} = \tan \Lambda_{REF} + \frac{2}{AR} \frac{(1-\lambda)}{(1+\lambda)} \left[\left(\frac{X}{C}\right)_{REF} - \left(\frac{X}{C}\right)_{EA}\right] \tag{111}$$

Should the vertical tail be on the fuselage, the load reference surface geometry is determined as shown in Figure 22. Equations 100 and 102 through 108 are then used to calculate the load reference geometry. The surface span is calculated by equation 112.

$$b = \frac{b_1}{2} + b_{exp} \tag{112}$$

where

$b_1/2$ = distance from the load reference root to the structure reference root

Should the horizontal tail be mounted on the vertical tail, the distance between the load reference root and the horizontal tail reference plane is calculated. Location of the horizontal tail is used to determine loads on the vertical tail introduced from the horizontal tail.

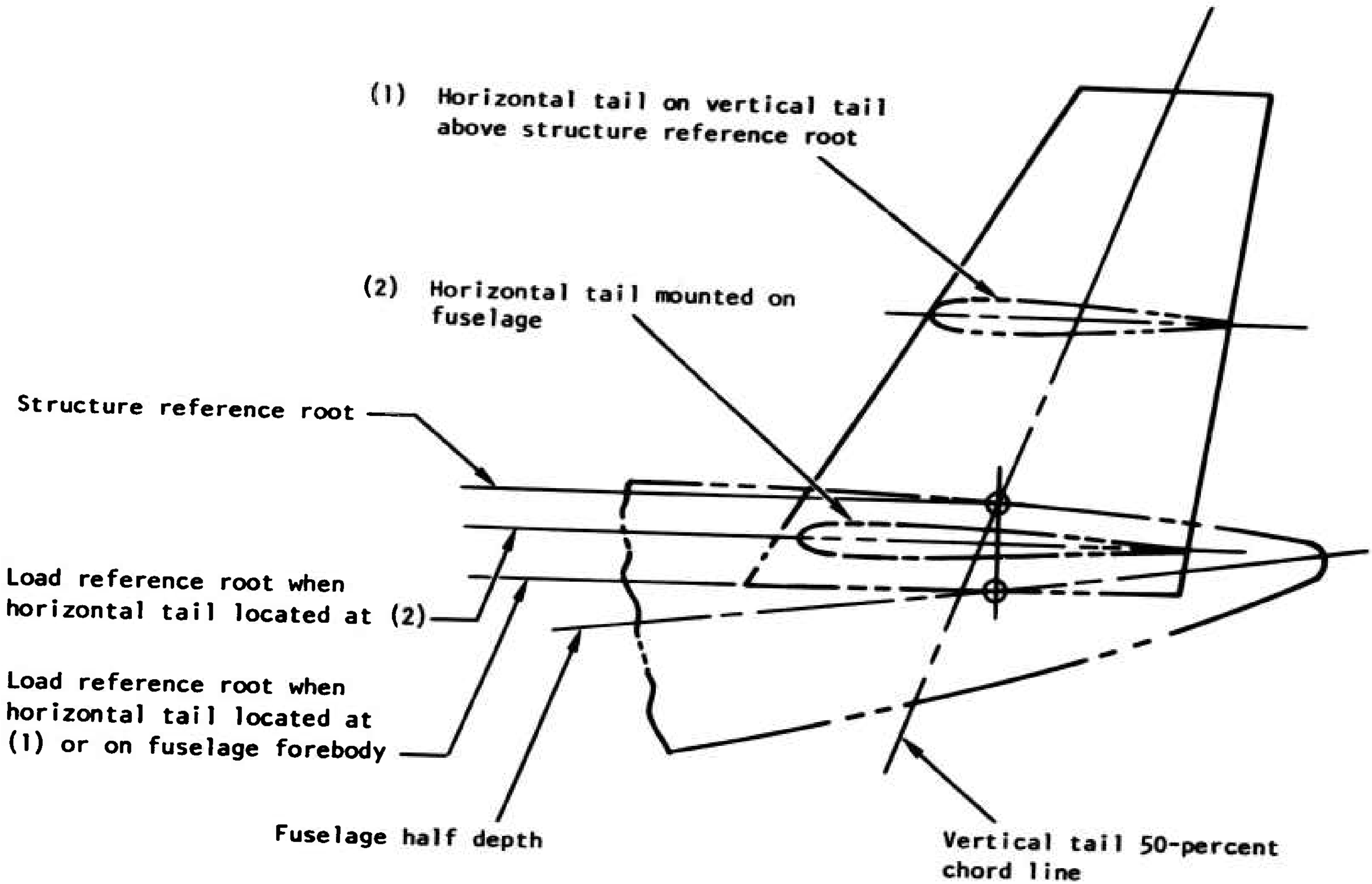


Figure 22. Location of vertical tail load reference root as a function of fuselage geometry and horizontal tail location.

NOSE (FOREBODY) GEOMETRY

Nose geometry is calculated in subroutine NOSGEO for use in the airloads module to calculate forebody lift. Nose length is defined to be the minimum distance from the fuselage nose station to any of the following stations:

1. Wing leading edge apex station

2. Horizontal tail leading edge apex station

3. First fuselage station at which cross-sectional area is constant or decreasing

4. Fuselage station at which there is a sharp change in geometry, as would occur at start of fuselage-mounted inlet ducts

Nose volume is calculated by summing fuselage volume up to the aft nose station as defined previously. Equivalent nose radius is calculated by equation 113.

$$\bar{R} = \sqrt{\frac{A_i}{\pi}} \tag{113}$$

where

A_i = fuselage cross-sectional area at aft nose station

INITIAL WEIGHT AND BALANCE CALCULATIONS

Vehicle weight and balance calculations are performed in subroutine QUIKIE. Table 20 shows the items which can be considered by this program in detail weight and balance calculations. On variable-sweep wing aircraft, the input center of gravity for the details is based on the sweep position used to define wing geometry. Several assumptions have been programmed concerning each of these items.

The following is a list of those items from Table 20 which, as a minimum, are assumed to exist on flight vehicles evaluated by this program.

TABLE 20. DETAIL WEIGHT ITEMS

ID No.	Item	ID No.	Item
1	Wing	25	Armament
2	Horizontal tail	26	Furnishings
3	Vertical tail	27	Air conditioning
4	Fuselage	28	Photographic
5	Main gear	29	Auxiliary gear
6	Nose gear	30	Other equipment
7	Surface controls	31	Crew
8	Engine section and nacelles	32	Trapped fuel
9	Other structure	33	Oil
10	Engine installation	34	Liquid nitrogen
11	Auxiliary gear boxes	35	Miscellaneous
12	Air induction system structure	36	Guns
		37	Wing pylons
13	Air induction system act. and mach	38	External wing tanks
14	Exhaust system	39	Fuselage pylons
15	Cooling and drains	40	External fuselage tanks
16	Lubricating system	41	Fuselage passengers or payload
17	Fuel system	42	Wing payload
18	Engine controls	43	Ammunition
19	Starting system	44	Wing fuel, inboard tank
20	Auxiliary power unit	45	Wing fuel, outboard tank
21	Instruments	46	Fuselage fuel, tank 1
22	Hydraulics	47	Fuselage fuel, tank 2
23	Electrical	48	Fuselage fuel, tank 3
		49	Fuselage fuel, tank 4
24	Electronics	50	Fuselage fuel, tank 5

ID No.	Item
1	Wing
2	Horizontal tail
3	Vertical tail
4	Fuselage
5	Main gear
6	Nose gear
7	Surface controls
8	Engine section and/or nacelles
9	Engine installation
12	Air induction system structure
31 and 44	Crew, wing fuel
or 46	Fuselage fuel

Weight and center of gravity for items 7, 9, 31, and 44 or 46 must be defined in the input data set. Should all of the remaining items in the foregoing list be defined in the input data set, subroutine QUIKIE calculates the operational weight empty, OWE, and balance by summing weight and balance data for items 1 through 40 in Table 20. Items 41 through 50 are expendable useful load items. These items are defined in terms of capacity and weight onboard at maximum design weight, basic flight design weight, and landing design weight. The vehicle weight and balance can then be calculated by combining the OWE with the appropriate expendable useful load items.

Should any or all of items 1 through 6, 8, and 12 be omitted in the input data set, QUIKIE uses statistical regression equations and rule-of-thumb methods to calculate initial estimates for those items. For this situation, the basic flight design weight (BFDW) and vehicle center of gravity defined in the input data set are assumed to be correct. Each of the structural components which are calculated is adjusted a proportionate amount such that, when they are combined with the weight items defined in the input data set, the BFDW is attained. Similarly, the calculated center of gravity is adjusted a proportionate amount such that the input CG at BFDW is maintained. Each of the calculated items is shifted a distance proportional to its characteristic length. Characteristic length for each structural component is tabulated in the following:

Item	Characteristic Length
Wing	MAC, mean aerodynamic chord
Horizontal tail	MAC, mean aerodynamic chord
Vertical tail	MAC, mean aerodynamic chord
Fuselage	Fuselage length
Main gear	Main gear strut length
Nose gear	Nose gear strut length
Engine section	Engine length
Air induction system structure	Inlet length from lip to engine front face

The following paragraphs present the statistical regression equations and rule-of-thumb methods which are used to calculate the weight and CG of the structural components (prior to adjustment).

WING WEIGHT AND BALANCE

Equation 114 is used to calculate the initial weight estimate for the wing.

$$W_W = \frac{(1.5N_Z W)^{.437} Q^{.132} S_W^{.758} (AR/\cos^2\Lambda_{c/4})^{.6} \lambda^{.04} KLG\ K_P\ K_W}{27.67\ [100(t/c)/\cos\Lambda_{c/4}]^{.296}} \qquad (114)$$

where

- W_W = weight of wing, lb
- 1.5 = limit to ultimate factor
- N_Z = maximum limit maneuver load factor
- W = BFDW, basic flight design weight, lb
- Q = maximum limit dynamic pressure, lb/ft^2
- S_W = gross wing area, ft^2
- AR = aspect ratio
- $\Lambda_{c/4}$ = sweep of quarter chord
- λ = taper ratio
- t/c = thickness to chord ratio at root
- KLG = landing gear increment:
  - 1.0 if gear mounted on fuselage
  - 1.05 if gear mounted on wing
- K_P = pivot increment:
  - 1.0 if fixed wing
  - $\left(1.35 - \frac{0.7\ Y_P}{b}\right)$ for variable-sweep wing
- Y_P = buttock line of pivot, in.
- b = wing span, in.
- K_W = wing weight index factor (1.0)

The wing center of gravity is estimated to be at 43 percent of the mean aerodynamic chord.

$$CG_W = LEMAC_W + 0.43\ MAC_W \tag{115}$$

where

CG_W = center of gravity station, in.

$LEMAC_W$ = leading edge station of mean aerodynamic chord, in.

MAC_W = mean aerodynamic chord, in.

HORIZONTAL TAIL WEIGHT AND BALANCE

Equation 116 is used to calculate the initial estimate of the horizontal tail weight.

$$W_H = \frac{(1.5N_Z W)^{0.414} Q^{0.168} S_H{}^{0.896} (AR/\cos^2\Lambda_{c/4})^{0.043}\ K_H}{63.27\ [100(t/c)/\cos\Lambda_{c/4}]^{0.121}\ \lambda^{0.025}} \tag{116}$$

where

W_H = weight of horizontal tail, lb

1.5 = limit to ultimate factor

N_Z = maximum limit maneuver load factor

W = BFDW, basic flight design weight, lb

Q = maximum limit dynamic pressure, lb/ft^2

S_H = gross horizontal tail area, ft^2

AR = aspect ratio

$\Lambda_{c/4}$ = sweep of the quarter chord

t/c = thickness to chord ratio at root

λ = taper ratio

K_H = horizontal tail weight index factor (1.0)

The horizontal tail center of gravity is estimated to be at 43 percent of the mean aerodynamic chord.

$$CG_H = LEMAC_H + 0.43\ MAC_H \tag{117}$$

where

CG_H = center of gravity station, in.

$LEMAC_H$ = leading edge station of mean aerodynamic chord, in.

MAC_H = mean aerodynamic chord, in.

VERTICAL TAIL WEIGHT AND BALANCE

Equation 118 is used to calculate the initial weight estimate for the vertical tail.

$$W_V = \frac{(1.5N_Z W)^{0.376} Q^{0.122} S_V^{0.873} (AR/\cos^2\Lambda_{c/4})^{0.357} \lambda^{0.039}\ N_V\ K_V}{13.72\ [100(t/c)/\cos\Lambda_{c/4}]^{0.489}} \tag{118}$$

where

W_H = weight of vertical tail, lb

1.5 = limit to ultimate factor

N_Z = maximum limit maneuver load factor

W = BFDW, basic flight design weight, lb

Q = maximum limit dynamic pressure, lb/ft^2

S_V = vertical tail area per panel, ft^2

AR = aspect ratio

$\Lambda_{c/4}$ = sweep of quarter chord

t/c = thickness to chord ratio at the root

λ = taper ratio

N_V = number of vertical tail panels

K_V = vertical tail weight index factor (1.0)

The vertical tail center of gravity is estimated to be at 43 percent of the mean aerodynamic chord.

$$CG_V = LEMAC_V + 0.43\ MAC_V \tag{119}$$

where

CG_V = center of gravity station, in.

$LEMAC_V$ = leading edge station of mean aerodynamic chord, in.

MAC_V = mean aerodynamic chord, in.

FUSELAGE WEIGHT AND BALANCE

Equation 120 is used to calculate the initial weight estimate for the fuselage.

$$W_F = \frac{0.052\ (1.5N_Z W)^{0.172}\ S_F^{1.124}\ Q^{0.241}\ K_F}{L_T^{0.047}\ (L/D)^{0.065}} \tag{120}$$

where

W_F = weight of fuselage, lb

1.5 = limit to ultimate factor

N_Z = maximum limit maneuver load factor

W = BFDW, basic flight design weight, lb

S_F = fuselage surface area, ft^2

Q = maximum limit dynamic pressure

L_T = tail arm, distance from wing quarter chord at mean aerodynamic chord to horizontal tail quarter chord, ft

L = fuselage length, in.

D = fuselage mean diameter, maximum depth plus maximum width divided by 2, in.

K_F = fuselage weight index factor (1.0)

The fuselage center of gravity is estimated to be at 55 percent of the body length on buried-engine-type configurations. For configurations where engines are in nacelles, fuselage center of gravity is estimated to be at 48 percent of the body length.

LANDING GEAR WEIGHT AND BALANCE

Either taxi or landing conditions may be critical for landing gear design. The maximum product of load factor times vehicle weight is used to determine the critical condition.

For the taxi condition,

$$N_Z = 2.0 \tag{121}$$

$$W = MDW \tag{122}$$

where

N_Z = vehicle load factor

W = vehicle weight, lb

MDW = maximum design weight, lb

For the landing condition,

$$N_Z = \frac{V^2}{2gS} \tag{123}$$

$$W = LDW \tag{124}$$

where

V = vehicle sink speed at landing design weight, ft/sec

g = acceleration of gravity, ft/sec^2

S = main gear stroke, ft

LDW = landing design weight, lb

Having determined the critical condition, equation 125 is then used to calculate the initial weight estimate for the landing gear.

$$W_{LG} = 0.2192\ N_Z^{0.4116}\ W^{0.7754}\ L^{0.2136} \tag{125}$$

where

W_{LG} = weight of alighting gears, lb

L = main gear strut length, ft

Equation 125 gives an estimate of the combined weight of the main and nose gears. This weight is allocated to the main and nose gears according to the static distribution of vehicle weight by equations 126 and 127.

$$W_{MG} = W_{LG} \left(\frac{CG - XNG}{XMG - XNG}\right) \tag{126}$$

$$W_{NG} = W_{LG} \left(\frac{XMG - CG}{XMG - XNG}\right) \tag{127}$$

where

W_{MG} = weight of main gear, lb

CG = vehicle center-of-gravity station at basic flight design weight, in. (this value is used, since the center of gravity at the maximum design weight is not known when this estimated is made)

XNG = longitudinal station of nose gear tires, in.

XMG = longitudinal station of main gear tires, in.

W_{NG} = weight of nose gear, lb

Since flight loads generally determine design of most of the structural components, the center of gravity for the main gear is taken in the retracted position. This location is defined in the input data set.

Nose gear center of gravity is assumed to be at the longitudinal station of the nose gear tires. The assumption here is that weight moment change is negligible for the nose gear in the extended position, as opposed to the gear in the retracted position.

AIR INDUCTION SYSTEM WEIGHT AND BALANCE

Ducts and, if they exist, two-dimensional variable geometry ramps or three-dimensional spikes are defined to constitute the air induction system structure.

Ducts

Equation 128 is used to calculate the initial weight estimate for continuous duct sections. If the maximum ultimate duct pressure is less than 10 pounds per square inch, equation 129 is used to calculate the duct weight. The initial weight estimate for a one-dimensional inlet leading edge, should it exist, is calculated by equation 130. The subscript, i, in these equations designates the duct segments defined by the input cuts.

$$W_{Di} = SFD_i \left[1.5 + \left(\frac{P-10.0}{10.0}\right)^{0.5}\right] K_D \tag{128}$$

$$W_{Di} = SFD_i \; (1.5) \; K_D \tag{129}$$

$$WD_i = SFD_i \; (4.0) \; K_D \tag{130}$$

where

W_{Di} = weight of duct segment i, lb

SFD_i = duct or inlet lip surface area for segment i, ft^2

P = maximum ultimate duct pressure, $lb/in.^2$

K_D = air induction system weight index factor (1.0)

Maximum ultimate duct pressure is determined to be the maximum of the values obtained by equations 131 through 133. The constants in these equations are the factor of safety applicable to the pressure conditions and associated flight profiles.

$$P = 1.5 \; PST \tag{131}$$

$$P = 1.5 \; PHEH \tag{132}$$

$$P = 1.2 \; PHEL \tag{133}$$

where

PST = maximum static gage pressure at engine face on limit speed envelope, $lb/in.^2$

PHEH = maximum hammershock gage pressure at engine face on level-flight maximum speed envelope, $lb/in.^2$

PHEL = maximum hammershock gage pressure at engine face on limit speed envelope, $lb/in.^2$

The duct center of gravity is calculated by summing the product of segment weights and individual centroids.

Two-Dimensional Variable Geometry Ramps

Equation 134 is used to calculate the initial weight estimate for variable geometry ramps.

$$W_R = SN \left[2.0 + \left(\frac{P}{10}\right)^{0.5} \right] K_D \tag{134}$$

where

W_R = weight of ramps per air vehicle, lb

S = ramp surface area per inlet, ft^2

P = maximum ultimate hammershock pressure, $lb/in.^2$

N = number of inlets per air vehicle

K_D = air induction system weight index factor (1.0)

Maximum ultimate hammershock pressure is determined to be the maximum of the values obtained by equations 135 and 136.

$$P = 1.5 \text{ PHTH} \tag{135}$$

$$P = 1.2 \text{ PHTL} \tag{136}$$

where

PHTH = maximum hammershock absolute pressure at inlet throat on level-flight maximum speed envelope, $lb/in.^2$

PHTL = maximum hammershock absolute pressure at inlet throat on limit speed envelope, $lb/in.^2$

The center of gravity of the ramps is assumed to be midway between the forward and aft ramp stations.

Three-Dimensional Spikes

Equations 137 through 139 from reference 4 are used to calculate the initial weight estimates for the different types of 3-D spikes. The center of gravity of the spike is assumed to be at the inlet throat.

Half-round fixed spike weight, W_S:

$$W_S = 12.53 (N)(A) \tag{137}$$

where

N = number of inlets per vehicle

A = inlet capture area, ft^2

Full-round translating spike weight, W_S:

$$W_S = 15.65\ (N)(A) \tag{138}$$

Translating and expanding spike weight, W_S:

$$W_S = 51.8\ (N)(A) \tag{139}$$

NACELLE AND ENGINE SECTION WEIGHT AND BALANCE

Engine mounts and, if they exist, nacelles and pylons are defined to constitute the engine section and nacelle group.

Engine Mounts

The initial weight estimate for engine mounts is calculated by equation 140. The center of gravity is assumed to be at the engine CG.

$$W_M = 0.015\ (W_E) \tag{140}$$

where

W_E = installed engine weight, lb

Nacelles

Equation 141 is used to calculate the initial weight estimate for nacelle segments. Should a one-dimensional leading edge segment exist on the nacelle, that part of the structure is attributed to inlet duct, as previously discussed. The center of gravity is calculated by summing the product of segment weight and individual centroids.

$$W_{Ni} = SFN_i\ (2.5) \tag{141}$$

where

W_{Ni} = weight of nacelle segment i other than one-dimensional leading edge segment, lb

SFN_i = nacelle surface area for segment i, ft^2

Pylons

Equation 142 is used to calculate the initial weight estimate for pylons. Since inboard and outboard pylons may be different, separate calculations are performed for each pylon. The center of gravity is determined by equation 143.

$$W_P = S_P \ (12.0) \tag{142}$$

$$CG_P = CG_E + \frac{L}{2} \sin \Lambda_P \tag{143}$$

where

S_P = pylon planform area, ft^2

CG_E = engine center of gravity

L = length of pylon, in.

Λ_P = sweep angle of pylon

WEIGHT DISTRIBUTION

Weight distributions are required for calculating vehicle weight moment of inertia for airload and net load calculations. The function of distributing the weight of structure and contents is performed by eight subroutines.

Subroutine WEIDST performs the first-level distribution by taking the operational weight empty data, items 1 through 40 in Table 20, and distributing the weight to the fuselage, wing, horizontal tail, vertical tail, inboard nacelles or engine package, and outboard nacelles.

Subroutine WNGDST distributes those items in the wing.

Subroutine FUSDST distributes the fuselage structure weight to the shell segments. FUSDST calls DSTTRI to perform part of this distribution. Subroutine CONDST distributes the operational weight empty contents in the fuselage, and FTOTAL distributes the expendable useful load. Both CONDST and FTOTAL call DSTNOR and DSTTRP to do the detail distributions.

Methods used in the foregoing eight subroutines are described in the following paragraphs.

FIRST-LEVEL WEIGHT DISTRIBUTION

Rule-of-thumb procedures have been programmed in subroutine WEIDST to distribute the operational weight empty items. Table 21 shows the fractional distribution of weight between functional groups. Should there be four nacelles on the vehicle, items associated with the engine package are divided into inboard and outboard engine packages. In this case, nacelle pylons calculated in QUIKIE may differ between the inboard and outboard sets; therefore, distribution of this line item is accomplished in QUIKIE. Distribution of all other engine-related items is accomplished in WEIDST. Those items in Table 4 which are allocated to more than one functional group are discussed in the following paragraphs.

Surface Controls

The weight of surface controls is assumed to be concentrated at the wing, horizontal tail, vertical tail, and the cockpit. A portion of the weight is assumed to be distributed between the cockpit controls and the surfaces. The rule-of-thumb distribution is shown in Table 22. Weights concentrated at the surfaces are assumed to be at the respective surface centers of gravity. That portion of surface controls concentrated at the cockpit is assumed to be 10 inches forward of the crew center of gravity. The center of gravity of the portion distributed between the cockpit and the surfaces is calculated such that the total center of gravity is maintained.

Fuel System and Trapped Fuel

Fuel system and trapped fuel are distributed in proportion to the wing and fuselage fuel capacities. If fuel is only in the wing or only in the fuselage, all of fuel system and trapped fuel is with the appropriate component. The center of gravity is that defined in the input data set.

Should fuel be in both the wing and the fuselage, that portion of fuel system and trapped fuel in the wing is assumed to be at the total wing fuel center of gravity. That portion in the fuselage is assumed to have a center of gravity such that the total center of gravity defined in the input data set is maintained.

TABLE 21. RELATIVE DISTRIBUTION OF OPERATIONAL WEIGHT EMPTY ITEMS

Item	Fraction in Fuselage	Fraction in Wing	Fraction in Horiz Tail	Fraction in Vert Tail	Fraction With Engine Package
Wing	-	1.0	-	-	-
Horizontal tail	-	-	1.0	-	-
Vertical tail	-	-	-	1.0	-
Fuselage	1.0	-	-	-	-
Main gear	D	D	-	-	-
Nose gear	1.0	-	-	-	-
Surface controls	*	*	*	*	-
Engine section	-	-	-	-	1.0
Other structure	1.0	-	-	-	-
Engine	-	-	-	-	1.0
Aux gearboxes	-	-	-	-	1.0
Air ind sys struct	-	-	-	-	1.0
Air ind sys act. & mech	-	-	-	-	1.0
Exhaust system	-	-	-	-	1.0
Cooling & drains	-	-	-	-	1.0
Lubricating system	-	-	-	-	1.0
Fuel system	*	*	-	-	-
Engine controls	1.0	-	-	-	-
Starting system	-	-	-	-	1.0
Auxiliary power unit	D	-	-	-	D
Instruments	*	*	-	-	*
Hydraulics	0.67	-	-	-	0.33
Electrical	0.75	-	-	-	0.25
Electronics	1.0	-	-	-	-
Armament	1.0	-	-	-	-
Furnishings	1.0	-	-	-	-
Air conditioning	0.80	-	-	-	0.20
Photographic	1.0	-	-	-	-

TABLE 21. RELATIVE DISTRIBUTION OF OPERATIONAL WEIGHT EMPTY ITEMS (CONCL)

Item	Fraction in Fuselage	Fraction in Wing	Fraction in Horiz Tail	Fraction in Vert Tail	Fraction With Engine Package
Auxiliary gear	1.0	-	-	-	-
Other equipment	1.0	-	-	-	-
Crew	1.0	-	-	-	-
Trapped fuel	*	*	-	-	-
Oil	-	-	-	-	1.0
Liquid nitrogen	1.0	-	-	-	-
Miscellaneous	1.0	-	-	-	-
Guns	1.0	-	-	-	-
Wing pylons	-	1.0	-	-	-
Ext wing tanks	-	1.0	-	-	-
Fuselage pylons	1.0	-	-	-	-
Ext fus tanks	1.0	-	-	-	-

NOTE D = dependent on input location definition.
* = determined by various considerations.

TABLE 22. SURFACE CONTROLS DISTRIBUTION

Configuration Code W, H, V*	Fraction of Total Surface Control Weight				
	Wing	Horizontal Tail	Vertical Tail	Fuselage Cockpit	Fuselage Distributed
0, 0, 0	0.532	0.128	0.124	0.038	0.178
0, 0, 1	0.457	0.110	0.247	0.033	0.153
0, 1, 0	0.464	0.239	0.108	0.034	0.155
0, 1, 1	0.406	0.209	0.220	0.029	0.136
1, 0, 0	0.608	0.108	0.103	0.032	0.149
1, 1, 0	0.541	0.205	0.092	0.029	0.133
1, 0, 1	0.534	0.094	0.213	0.028	0.131
1, 1, 1	0.482	0.182	0.192	0.026	0.118

* W, wing	0 = fixed	1 = variable sweep
H, horizontal tail	0 = elevator type	1 = all moveable type
V, vertical tail	0 = rudder type	1 = all moveable type

Instruments

Instruments are assumed to be distributed as follows:

Fraction of Total Weight	Location	Center of Gravity
0.10	Fuel	Fuel CG
0.10	Engine	Engine CG
0.80	Fuselage	To match input total CG

Hydraulics, Electrical, and Air Conditioning

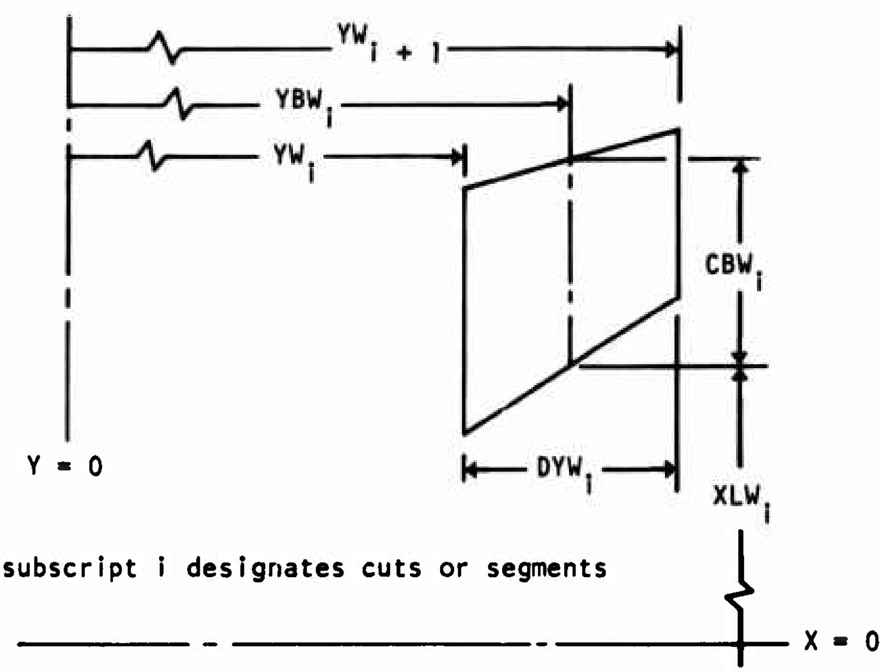
Hydraulics, electrical, and air conditioning group weights are distributed between the fuselage and engine packages as shown in Table 21. That portion of hydraulics and electrical group weights associated with the engine package is assumed to be half an engine diameter forward of the engine front face. That portion of air conditioning group weight associated with the engine package is at the engine center of gravity. Centers of gravity of the portions of weight allocated to the fuselage are calculated such that input group centers of gravity are maintained.

WING AND CONTENT WEIGHT DISTRIBUTION

Spanwise weight distribution of wing and contents and local weight moment of inertia are calculated in subroutine WNGDST. Weight distributions are calculated for the wing weight, wing plus operational weight empty items (OWE), maximum design weight (MDW), basic flight design weight (BFDW), and landing design weight (LDW).

Geometry for Weight Distribution Purposes

The wing is divided into 12 segments for the purpose of calculating deadweight distributions and inertia. Figure 23 shows the orientation of these weight distribution cuts and segments relative to the structural synthesis cuts. Planform geometry for each of these segments is defined as shown in the following sketch.



where subscript i designates cuts or segments

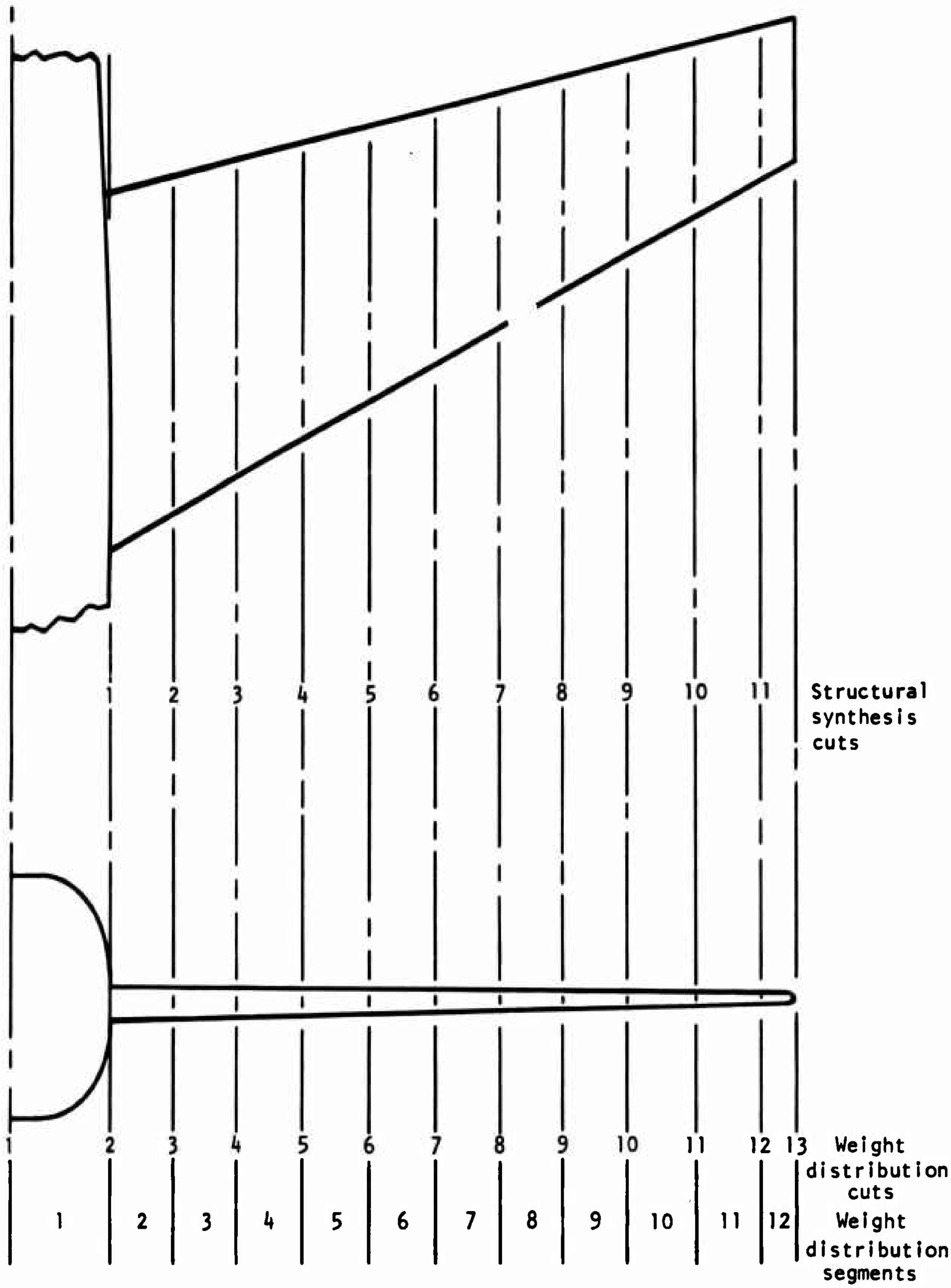


Figure 23. Wing distribution cuts and segments.

Unit pitch (UY), roll (UX), and yaw (UZ) inertia of weight within a segment is calculated by geometry function equations 144 through 146. These unit inertias, when multiplied by the distributed weights, define the local weight moment of inertia for the segment.

$$UX_i = \left[(DYW_i)^2 + (0.8\ t/c\ CBW_i)^2 \right] /12 \tag{144}$$

$$UY_i = \left[(0.8\ CBW_i)^2 + (0.8\ t/c\ CBW_i)^2 \right] /12 \tag{145}$$

$$UZ_i = \left[(DYW_i)^2 + (0.8\ CBW_i)^2 \right] /12 \tag{146}$$

where

t/c = thickness to chord ratio

0.8 = constant for idealizing airfoil geometry to rectalinear box

Weight Distribution

Three basic approaches are used to distribute wing and content masses. A parabolic-shaped spanwise distribution is assumed for the wing structure, surface controls, fuel system, instruments, trapped fuel, pylons, and external tanks. The latter two items are distributed in this manner, since geometric data and lateral location are not defined in the input data set. Landing gear and external stores are considered to be concentrated masses which are distributed between two adjacent segments. Should externals stores be outboard of the wingtip or the lateral centroid (YBW) of the last segment, the weight is distributed as a couple between the last two segments. The third approach is used to distribute wing fuel. This method assumes a distribution proportional to the segment volume.

The parabolic-shaped spanwise weight distribution is obtained by equation 147.

$$WWT_i = \left. \frac{W_W\ (b/2 - y)^{3/2}}{(b/2)^{3/2}} \right|_{y = YW_{i+1}}^{y = YW_i} \tag{147}$$

where

WWT_i = weight of wing structure in segment i, lb

W_W = total wing structure weight, lb

b = wing span, in.

The lateral centroid (YBW) of weight within a segment is assumed to be midway between bounding cuts. The longitudinal centroid (XBW) is assumed to be along a constant-percent chord line.

Concentrated masses are distributed between two adjacent segments whose centroids are immediately inboard and outboard of the lateral centroid of the mass. Equations 148 and 149 determine the weight distribution.

$$WT_i = W_c \left(\frac{Y_c - YBW_i}{YBW_{i+1} - YBW_i} \right) \tag{148}$$

$$WT_{i+1} = W_c - WT_i \tag{149}$$

where

WT = weight distributed in respective segment

W_C = total weight of concentrated mass

Y_C = lateral coordinate of concentrated mass

The longitudinal centroid of the weight is maintained by assuming that the weight distributed in the two segments are at the same percent chord. There may be either one or two external store stations on each wing panel. Should there be two store stations, the lateral locations of each and the longitudinal location of the total are defined in the input data set. The weight is assumed to be located equally between the inboard and outboard store stations. Longitudinal centroid is determined by equations 150 and 151. Since store geometry is not defined, stores are assumed to be within the confines of the respective segments, for the purpose of calculating local weight moment of inertia.

$$X_{c_1} = X_c - \left(\frac{Y_{c_2} - Y_{c_1}}{2} \right) \tan \Lambda_{LE} \tag{150}$$

$$X_{c_2} = X_c + \left(\frac{Y_{c_2} - Y_{c_1}}{2} \right) \tan \Lambda_{LE} \tag{151}$$

where

X_c = X-centroid of wing external stores, in.

Λ_{LE} = sweep of leading edge

X_{c_1} = X-centroid of inboard store, in.

X_{c_2} = X-centroid of outboard store, in.

Y_{c_1} = Y-centroid of inboard store, in.

Y_{c_2} = Y-centroid of outboard store, in.

Internal wing fuel is distributed in those segments between the inboard and outboard fuel ribs in proportion to the segment volume. Should a fuel rib fall within a segment, the applicability of that segment, for purpose of weight distribution, is determined by the extent of fuel in the segment. If at least half of the segment span (DYW) contains fuel, fuel is distributed in that segment. Relative volume of each of the segments is calculated by equation 152.

$$VOL_i = DYW_i \; CBW_i \left[1 - \frac{(1-\lambda\sigma) \; YBW_i}{b/2} \right] \tag{152}$$

The fuel is then distributed by equation 153.

$$WT_i = W_F \frac{VOL_i}{\Sigma VOL} \tag{153}$$

where

σ = thickness taper ratio

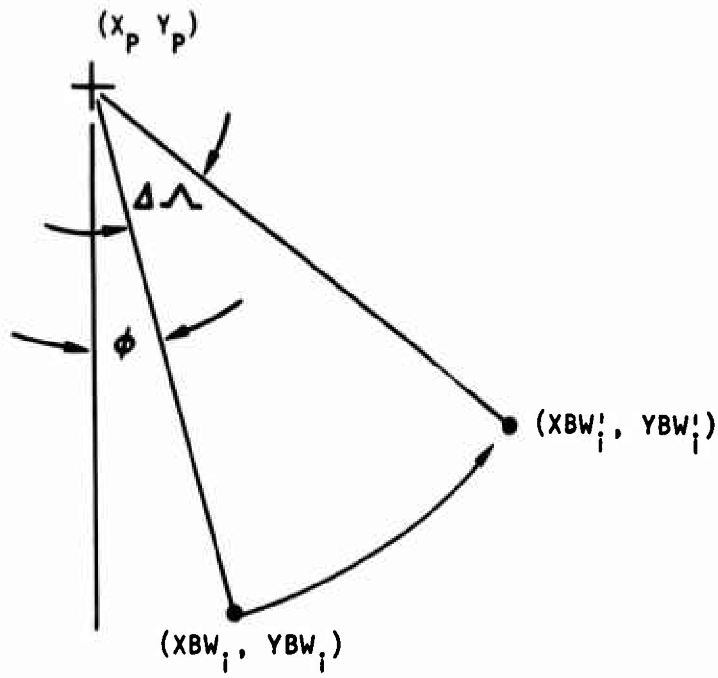
W_F = weight of fuel in wing tank, lb

Longitudinal centroid of fuel in each segment is assumed to be along a constant chord line which is determined from the total fuel center of gravity. The foregoing approach is taken to distribute fuel in as many as two wing tanks.

Wing structure, surface controls, fuel system, instruments, trapped fuel, pylons, and external tanks weight distributions are combined to obtain the operational weight empty (OWE) distribution. This distribution is combined with the corresponding useful load (fuel and payload) to obtain distributions for the MDW, BFDW, and LDW.

Variable-Sweep Wing Distribution

The distributions are applicable for fixed-wing aircraft. On variable-sweep wings, the same calculations are performed for the input nominal wing planform. Coordinates of the distributed weight are then calculated for the forward and aft sweep positions. For segments inboard of the pivot, there is no change in centroid coordinates. Rotation trigonometry for segments outboard of the pivot is shown in the following sketch.



where

$\Delta\Lambda$ = change in sweep angle between nominal wing position and load evaluation position

XBW_i' = X-centroid of segment weight after rotation, in.

YBW_i' = Y-centroid of segment weight after rotation, in.

X_p = X-coordinate of pivot, in.

Y_p = Y-coordinate of pivot, in.

$$\phi = \tan^{-1}\left(\frac{XBW_i - X_p}{YBW_i - Y_p}\right) \tag{154}$$

$$R = \left[(XBW_i - X_p)^2 + (YBW_i - Y_p)^2 \right]^{1/2} \tag{155}$$

$$XBW_i' = X_p + R \sin (\phi + \Delta\Lambda) \tag{156}$$

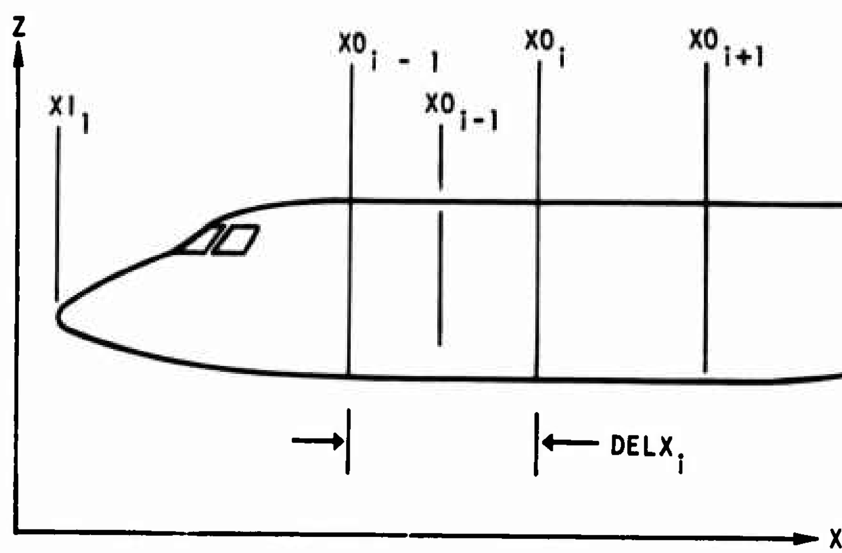
$$YBW_i' = Y_p + R \cos (\phi + \Delta\Lambda) \tag{157}$$

Due to wing rotation, unit pitch inertia about the vehicle reference coordinates calculated by equation 145 changes. Unit pitch inertia due to rotation is calculated by equation 158.

$$UY_i' = UY_i \cos^2 (\Delta\Lambda) + UX_i \sin^2 (\Delta\Lambda) \tag{158}$$

FUSELAGE AND CONTENT WEIGHT DISTRIBUTION

The distribution of fuselage structure and contents weights is calculated by subroutines FUSDST, DSTTRI, CONDST, FTOTAL, DSTNOR, and DSTTRP. These routines distribute weights to the shell segments determined in geometry routine FUSGEO. The CG of weight distributed within a segment is assumed to be at the segment centroid. Geometric data used in these routines are shown in the following sketch.



where

XI_1 = nose reference station

XI_{10} = tail reference station

XO = synthesis cut station

XBAR = segment centroid

DELX = segment length

Subroutine FUSDST distributes fuselage structure in two parts. Half of the weight is distributed according to wetted area; subroutine DSTTRI is called to distribute the remainder by using a triangular-shaped distribution.

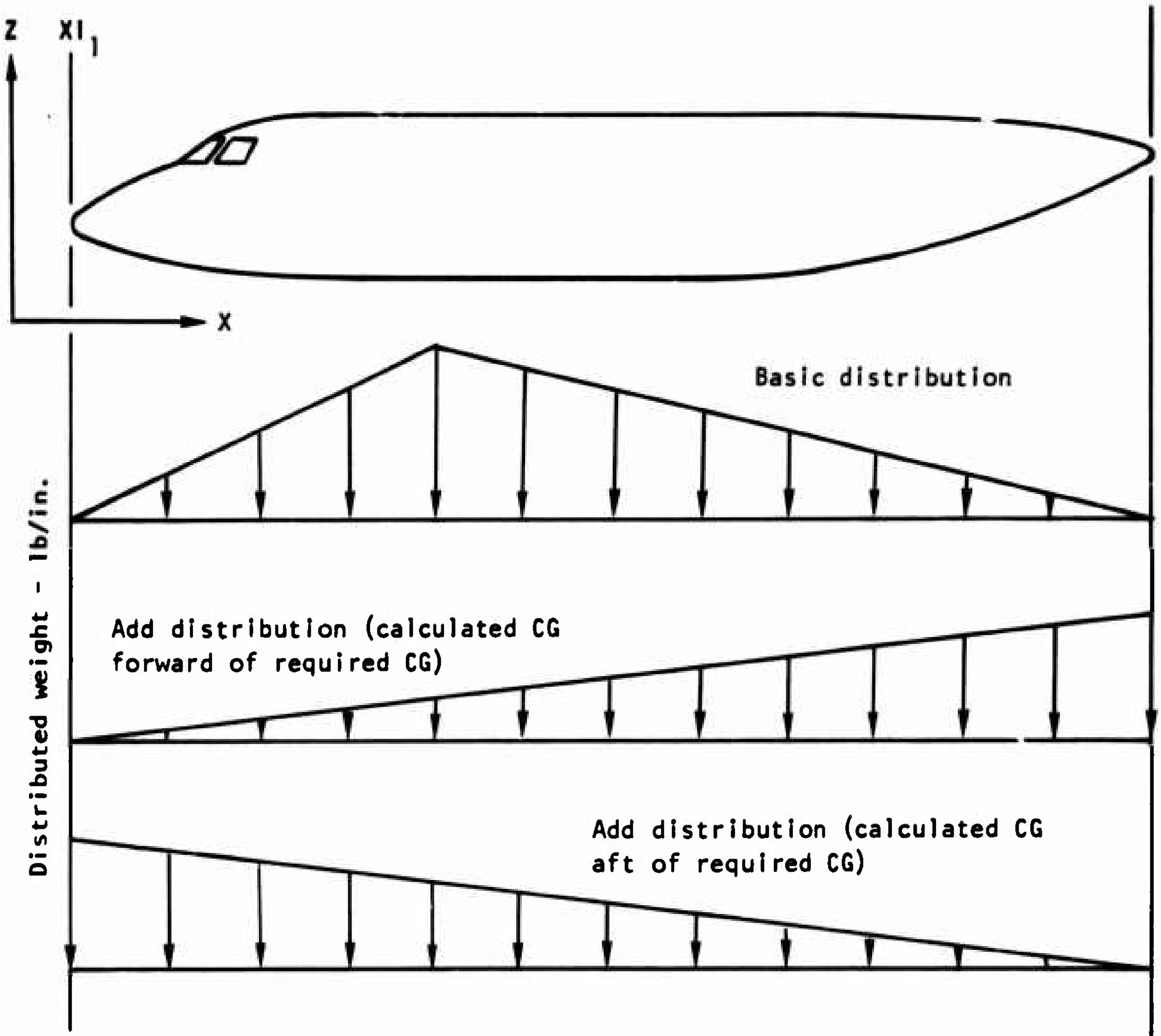
Subroutine CONDST distributes operational weight empty items (Table 21, first column). FTOTAL distributes the expendable useful load items for the different vehicle design weight, and combines these distributions with the operational weight empty distribution. Both routines use DSTNOR and DSTTRP to perform the detail distribution.

Fuselage Structure Weight Distribution

Half of the structure weight is distributed in proportion to the surface area of each shell segment. The centroid of the remainder of the weight is determined by subtracting the distributed portion from the total structure weight and CG. This portion is distributed according to a triangular shape by DSTTRI, as shown in the following sketch. The apex of the triangle is placed at the centroid of the segment which is immediately forward or at the CG of the weight to be distributed.

The basic distribution is used to calculate the amount of weight within each segment. Due to errors introduced by the selection of the apex point and the assumption of CG's at segment centroids, the basic distribution will not produce the proper total CG. One of the two add distributions is used to provide the necessary adjustment.

The distribution based on surface area approximates minimum gage-type structure, and the triangular distribution approximates the influence of loads.



Fuselage Content Weight Distribution

Routines CONDST and FTOTAL examine each content item weight and CG and call either DSTNOR or DSTTRP to distribute the weight. These routines use two distribution approaches.

Normal Distribution

Certain items are concentrated such that the mass can be assumed to be localized within a few fuselage segments. DSTNOR distributes items that fall in this category. In general, DSTNOR distributes weight between two adjacent segments whose centroids are just forward and aft of the item CG.

However, if the aft or forward segments are relatively short (4 inches or less), the weight is distributed between three segments. In the case where two segments are involved, equations 159 and 160 are used to distribute weight between segments j and k.

$$WT_k = W_c \frac{(X_c - XBAR_j)}{(XBAR_k - XBAR_j)} \tag{159}$$

$$WT_j = W_c - WT_k \tag{160}$$

where

WT = distribution of weight between segments k and j

W_C = weight of concentrated item, lb

X_C = X-CG of concentrated weight item

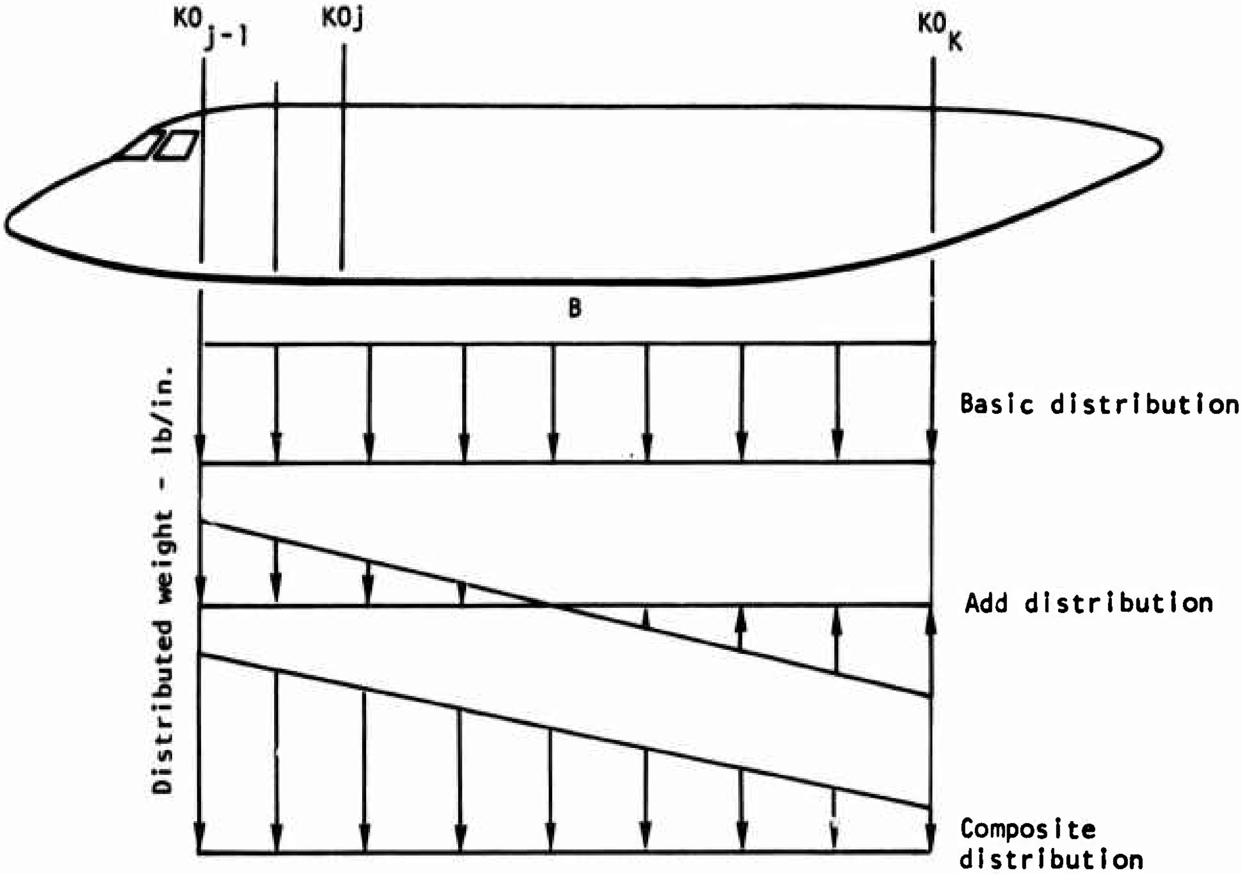
In the case where three segments are involved, the short segment is the middle segment, n, bounded by segments j and k. Equation 161 is used to distribute weight in the short segment. The weight and CG of the remainder are calculated, and equations 159 and 160 are used to distribute weight to the other segments.

$$WT_n = \frac{W_c \, DELX_n}{DELX_j + DELX_n + DELX_k} \tag{161}$$

Trapezoidal Distributions

Items such as control cables, electrical wiring, and fuel are distributed by DSTTRP. Weight is distributed to the segments j through k, as shown in the following sketch.

The basic uniform distribution is combined with a triangular-shaped add distribution to obtain a composite trapezoidal-shaped distribution. The proportion of the basic and add shapes are calculated such that the distribution is consistent with the weight and CG of the item. The calling routine defines the weight CG, and forward and aft distribution limits. Should the distribution limits fall within one segment or two adjacent segments, DSTTRP calls DSTNOR to distribute the weight.



Due to methods involved in the first-level weight distribution calculated by WEIDST and further breakdown of the weight in CONDST and FTOTAL, weight, CG, and distribution limits could result in negative weight in some segments. Should this condition exist, the calling routine would use DSTNOR in place of DSTTRP.

Operational Weight Empty Distribution

Subroutine CONDST distributes operational weight empty contents by calling either DSTNOR or determining distribution limits and calling DSTTRP. Items explicitly defined to be in the fuselage by the first-level weight distribution WEIDST are shown in Table 23. Those items in the table which are distributed by DSTTRP or go through further subdivision are discussed in the following paragraphs.

Surface controls (distributed), hydraulics, electrical, and air-conditioning weights are assumed to extend from the cockpit controls to the most aft surface quarter-chord station of the mean aerodynamic chord. DSTTRP is used to distribute weight between these limits.

TABLE 23. DISTRIBUTION OF FUSELAGE OPERATIONAL WEIGHT EMPTY CONTENTS

Item	Distribution Approach	
	DSTNOR	DSTTRP or Complex
Main gear	X	
Nose gear	X	
Surface controls (cockpit)	X	
Surface controls (distributed)		X
Other structure	X	
Fuel system		X
Engine controls		X
Auxiliary power unit	X	
Instruments		X
Hydraulics		X
Electrical		X
Electronics		X
Armament		X
Furnishings		X
Air conditioning		X
Photographic	X	
Auxiliary gear	X	
Other equipment	X	
Crew	X	
Trapped fuel		X
Liquid nitrogen	X	
Miscellaneous	X	
Guns	X	
Pylons	X	
External tanks	X	

Fuel system and trapped fuel are distributed by DSTTRP between the forward and aft limits of the fuselage fuel tanks.

Engine controls are assumed to be distributed from the cockpit controls aft to the engine CG. Should the engines be in wing-mounted nacelles, the quarter-chord station of the wing mean aerodynamic chord is the aft limit used in subroutine DSTTRP.

Seventy percent of the total instrument group (input total) is assumed to be concentrated with the cockpit controls and is distributed by DSTNOR. The remainder of fuselage-contained instruments is distributed by DSTTRP from the cockpit controls to the most aft surface quarter-chord station of the mean aerodynamic chord.

Electronic equipment is assumed to be concentrated in either one, two, or three compartments. Should there be only one compartment, all of the weight is distributed by DSTNOR at the group CG. Should there be two compartments, weight is assumed to be concentrated at the compartment stations in a proportion that maintains the total group CG. For the case where three compartments are defined in the input data set, 50 percent of the weight is assumed to be in the second compartment; the remainder is distributed between the first and third compartments in the same manner as used for two compartments.

Armament group weight distribution is dependent on the presence or absence of guns. If guns exist on the vehicle, the minimum of either 500 pounds or 90 percent of the group weight is assumed to be concentrated at the gun CG. This approximation accounts for ammunition drums, feed systems, and gun blast shields which would be in the proximity of the guns. The remainder is distributed by DSTTRP. The forward limit of the distribution is at the cockpit controls station, and the aft limit an equal distance aft of the weight CG. If no guns exist, all of the armament group weight is distributed by DSSTRP between the same limits.

Furnishing weight is distributed by DSTTRP according to the vehicle type. The forward limit of the distribution is the cockpit controls station for all vehicle types. For fighter and bomber categories, the aft station is aft a distance equal to twice the difference between the cockpit controls and the weight CG. On transports, the aft limit is at the aft end of the cargo bay.

On vehicles with engines buried in the fuselage, weights associated with the engine package are distributed in the fuselage. Air induction system structure is distributed between the inlet leading edge station and the engine front face station by DSTTRP. The remaining engine-associated items, shown in the following list, are distributed by DSTNOR. Engine and exhaust system weights are combined prior to distribution. Combining these weights alleviates some of the problems associated with distribution of exhaust systems which are aft of the shell structure.

Engine Package Items

Engine section
Engine
Accessory gearboxes and drives
Air induction system structure
Air induction system mechanism and controls
Exhaust system
Cooling and drains
Lubricating system
Starting system
Auxiliary power unit
Instruments
Hydraulics
Electrical
Air conditioning
Oil

Expendable Useful Load and Total Content Distribution

Subroutine FTOTAL distributes the expendable useful load items at the MDW, BFDW, and LDW. These distributions are then combined with the operational weight empty distribution from CONDST to obtain the total fuselage weight distribution. Passengers or payload and fuel in as many as five internal tanks are distributed by DSTTRP. The respective cabin, weapons, bay, or fuel tank forward and aft stations are used to define the distribution limits.

VEHICLE WEIGHT AND BALANCE AND INERTIA

Vehicle weight, balance, and weight moment of inertia are calculated by subroutines AVDATA, AVDWNG, and AVDAOC. Calculations within these routines are performed for the load evaluation vehicle weights and wing sweep positions. An outline of the calculation process follows:

1. Subroutine AVDWNG calculates:

    a. Weight of wing and contents at MDW, BFWD, and LDW

    b. X-CG of wing and contents of MDW, BFDW, and LDW for forward and aft wing sweep positions

    c. Y-CG or wing and contents for one panel at MDW, BFWD, and LDW for forward and aft sweep positions

d. Pitch and yaw weight moment of inertia about wing and content X-CG and vehicle centerline by summing local inertias and local transfer terms

2. Subroutine AVDATA calculates:

a. Weight of fuselage and contents and X- and Z-CG's at MDW, BFDW, and LDW.

b. Horizontal tail and contents weight, X-CG, Y-CG of one panel, and pitch and yaw inertia about X-CG and Y-CG. Y-CG is approximated by equation 162. Equations 163 and 164 are used to estimate pitch and yaw inertia, respectively.

$$\text{Y-CG} = Y_{SF} + b_{exp}/3 \tag{162}$$

$$I_{YY} = \frac{W_H \, C_{SF}^2}{18} \tag{163}$$

$$I_{ZZ} = \frac{W_H \left(C_{SF}^2 + b_{exp}^2\right)}{18} \tag{164}$$

where

Y_{SF} = Y-coordinate of horizontal tail side of fuselage station, in.

b_{exp} = exposed semispan, in.

W_H = weight of horizontal tail and contents, lb

C_{SF} = horizontal tail chord at side of the fuselage, in.

c. Vertical tail and contents weight, X-CG, Z-CG, pitch inertia about X- and Z-CG's, and yaw inertia about Y-CG. Z-CG is approximated by equation 165. Equations 166 and 167 are used to estimate pitch and yaw inertia, respectively.

$$\text{Z-CG} = \frac{b}{3} \tag{165}$$

$$I_{YY} = \frac{W_V \, (C^2 + b^2)}{18} \tag{166}$$

$$I_{ZZ} = \frac{W_V C^2}{18} \tag{167}$$

where

- b = structure reference span, in.
- C = structure reference root chord, in.
- W_V = weight of vertical tail and contents, lb

d. Nacelle and content weight and X-CG for inboard and outboard nacelles, should either or both exist.

e. Pitch and yaw inertia about nacelle and contents X-, Y-, and Z-CG's. Y- and Z-CG's are assumed to be at nacelle geometric centroids. For purpose of calculating inertia, nacelle and content weights are assumed to be distributed in proportion to nacelle surface area. Inertias are then calculated by summing local inertias and local transfer terms.

f. Vehicle weight and X- and Z-CG's at MDW, BFDW, and LDW for forward and aft wing sweep positions by combining contributions of wing and content, fuselage and contents, horizontal tail and contents, vertical tail and contents, and nacelle and contents.

g. Fuselage and content contribution to vehicle pitch and yaw inertia by summing local inertias and local transfer terms.

3. Subroutine AVDAOC calculates vehicle pitch and yaw inertias by combining fuselage and content contributions with that of wing, horizontal tail, vertical tail, and nacelles; pitch and yaw inertia are calculated for:

   a. BFDW with wing in forward and aft positions

   b. MDW with wing fixed or in forward position

   c. LDW with wing fixed or in forward position

Data developed in the foregoing manner are organized by subroutine AVDINR in a separate record for use by the fuselage weight estimation module. Should all structural components be supported directly by the fuselage, weight, CG, and inertia of the individual components and contents are stored separately. Should nacelles and/or vertical tails be on the wing, these items are combined with the wing and contents.

SURFACE INERTIAL LOADS

Wing, horizontal tail, and vertical tail inertia loads are required by the airloads module for calculating net loads. Subroutine DFATMG calculates wing inertia bending moments for use in developing fatigue spectra loads. Subroutine DMAXLD calculates wing, horizontal tail, and vertical tail inertia shear, bending moment, and torque for use in the development of net surface loads. Wing net taxi loads are also calculated by subroutine DMAXLD.

Wing weight distributions calculated by subroutine WNGDST are integrated to obtain inertia loads per unit load factor. Empennage weight distributions are not available and, therefore, are calculated in DMAXLD. A parabolic spanwise distribution is assumed for both the horizontal tail and contents and the vertical tail and contents. Thirteen weight distribution cuts are defined for the horizontal tail and vertical tail in the same manner as used for the wing (Figure 8). Weight distribution methods are identical to that used to distribute wing structure weight and are obtained by substitution of the appropriate parameters in equation 147.

1 G INERTIA LOADS

Shear per unit load factor is calculated by equation 168. The summation is performed from the segment outboard of the cut to the tip segment, segment 12.

$$V_i = - \sum_{j}^{12} WT_j \tag{168}$$

where

V_i = shear per unit load factor at cut i, lb

WT_j = weight of structure and contents in segment j, lb

Bending moment normal to the load reference line is determined by equation 169.

$$BM_i = - \sum_{j=i+1}^{j=12} WT_j \, \Delta Y_{\Lambda j} \tag{169}$$

where

$\Delta Y_{\Lambda j}$ = distance parallel to elastic axis from CG of distributed weight to load evaluation cut which is calculated by equation 170.

$$\Delta Y_{\Lambda j} = \left[X_j - XEA_i - (Y_j - YEA_i) \tan \Lambda_{EA}\right] \sin \Lambda_{EA} + (Y_j - YEA_i)/\cos \Lambda_{EA} \quad (170)$$

where

X_j = X-coordinate of distributed weight CG in segment j

Y_j = Y-coordinate of distributed weight CG in segment j

XEA_i = X-coordinate of elastic axis at load evaluation cut i

YEA_i = Y-coordinate of elastic axis at load evaluation

Λ_{EA} = sweep angle of elastic axis, deg

Torque about the load reference line is calcluated by equation 171.

$$T_i = \sum_{j=i+1}^{j=12} WT_j \, \Delta X_{\Lambda j} \quad (171)$$

where

$\Delta X_{\Lambda j}$ = normal distance from elastic axis to CG of distributed weight is calculated by equation 172.

$$\Delta X_{\Lambda j} = \left[X_j - XEA_i - (Y_j - YEA_i) \tan \Lambda_{EA}\right] \cos \Lambda_{EA} \quad (172)$$

WINGLOADS

Equations 168 through 171 are used by subroutine DMAXLD to calculate unit inertia loads at each of 11 load evaluation stations. Equation 169 is also used by subroutine DFATMG to calculate inertia bending moments at the outboard fatigue evaluation station, load evaluation station 2. Subroutine DFATMG uses equation 173 to calculate unswept bending moments at the inboard fatigue evaluation station, load evaluation station 1.

$$BM_1 = - \sum_{j=2}^{j=12} WT_j (Y_j - YEA_1) \tag{173}$$

Should nacelles be on the wing outboard of the load evaluation cut, nacelle and content inertia effects are added to the wing and content loads.

Net 2 g taxi loads are calculated at each of the load evaluation cuts. Should the main landing gear be on the fuselage or inboard of the load evaluation cuts, the net loads are twice the unit inertia loads. Should the landing gear be on the wing, equation 174 is used to calculate the vertical load introduced at the X- and Y-coordinates of the tires.

$$V = \frac{MDW\ (XCG - XNG)}{(XMG - XNG)} \tag{174}$$

where

MDW = maximum design weight, lb

XCG = vehicle X-CG at MDW with wing fixed or forward, in.

XNG = nose landing gear tire X-station, in.

XMG = main landing gear tire X-station, in.

Shear, moment, and torque due to the landing gear load are combined with the 2 g inertia loads to obtain net taxi loads at MDW.

EMPENNAGE LOADS

Equations 168 through 171 are used to calculate horizontal tail inertia loads per unit load factor. These same equation forms are used to calculate vertical tail inertia loads. The actual equations used are obtained by substituting Z-coordinates for Y-coordinates.

Section III

PROGRAM DESCRIPTION

GENERAL DISCUSSION

The function of the data management module is to develop compatible design data for use by the airloads and other program modules. Methods, equations, and logic discussed in the previous section have been programmed in FORTRAN IV for the CDC 6600 computer.

Corrective measures, warning messages, and error messages have been built into the program such that most user errors, will not result in catastrophic failure. In some cases, the warning is of a nature for which no user action is required. In other instances, incompatible data are either corrected, revised, or bypassed. The implications, probable cause, and recommended action associated with the various messages are presented in the subroutine discussions. Output prints of intermediate calculations are also provided to aid in the detection of user errors.

LOGIC FLOW

This module is structured into one overlay consisting of a control routine (DATAIN) and 28 subroutines. The module subroutine flow diagram is shown in Figure 24. System routines READMS and WRITMS are also shown in this diagram to indicate routines which read and store data in the mass storage file records. Figure 25 shows the flow of data from this module to the other program modules.

GENERAL MAPS

Data storage and transmittal is accomplished through the use of common, labeled common, and mass storage files. Mass storage file data, with the exception of the FUSDWI array, are read into and written from regions in common. The FUSDWI array is stored in the program region of subroutine AVDINR.

COMMON

Blank common consists of 4,400 cells, which are divided into the major regions shown in Table 24. Table 25 presents an alphabetical listing of arrays and variables within the common region. Type designates whether variable is input (I) or calculated (C). When variables in this table are subsets of

larger arrays, the higher order array is referenced in brackets. Tables 26 through 51 are maps of those arrays or parts of arrays that have specific significance which are not explained in the alphabetical listing.

LABELED COMMON

Labeled common arrays are used to transfer program control words and vehicle weight summary data. The IP array, IPRINT block, is used to transmit print controls to different routines as shown in Table 52.

The XMISC array, MISC block, is used to transmit certain vehicle design data as shown in Table 53.

MASS STORAGE FILES

Mass storage file records used by this program are shown in Table 54. Variables in these records are discussed in the common region tables or in the discussion of subroutine AVDINR.

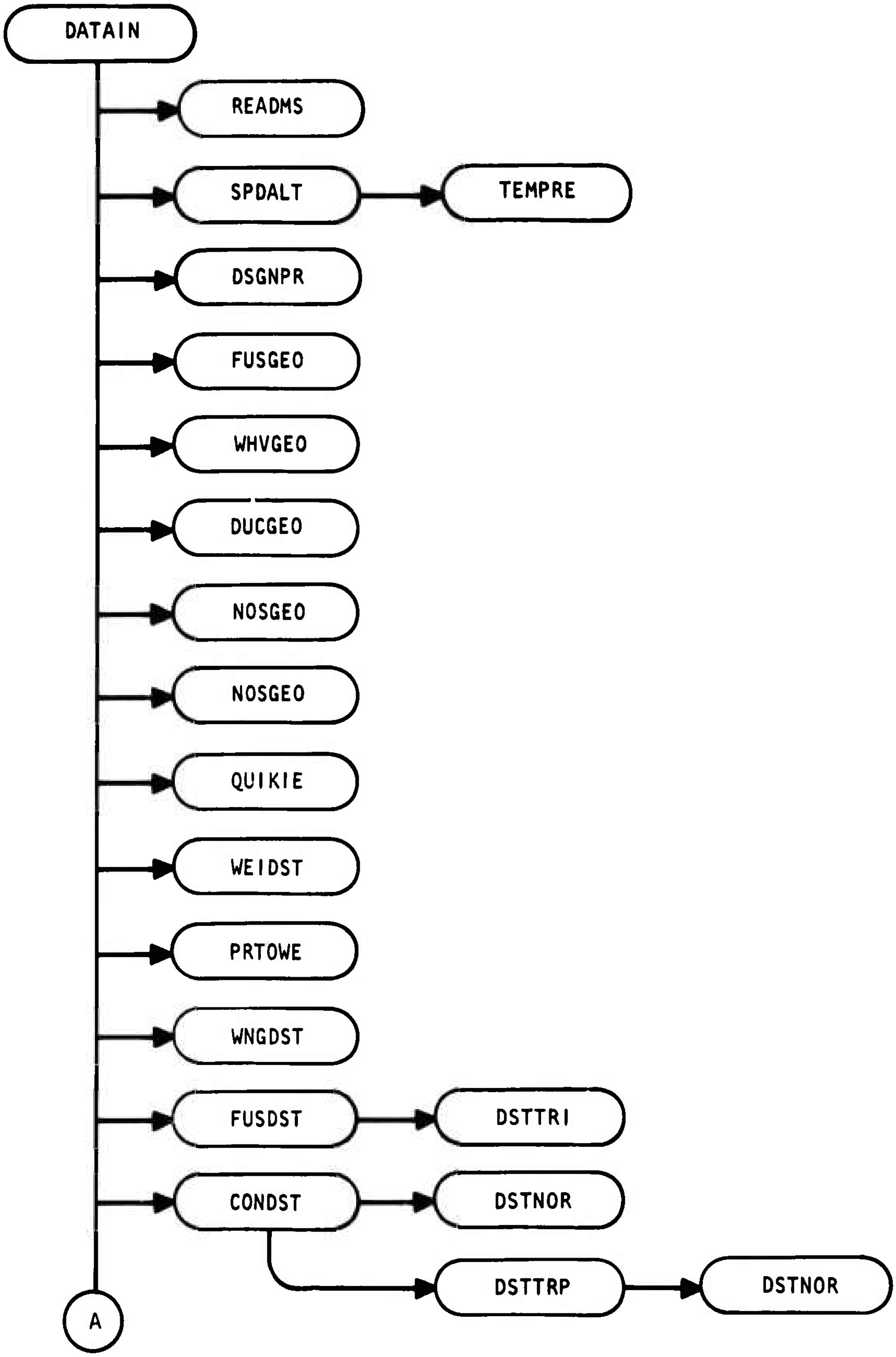


Figure 24. Data management module subroutine flow diagram.

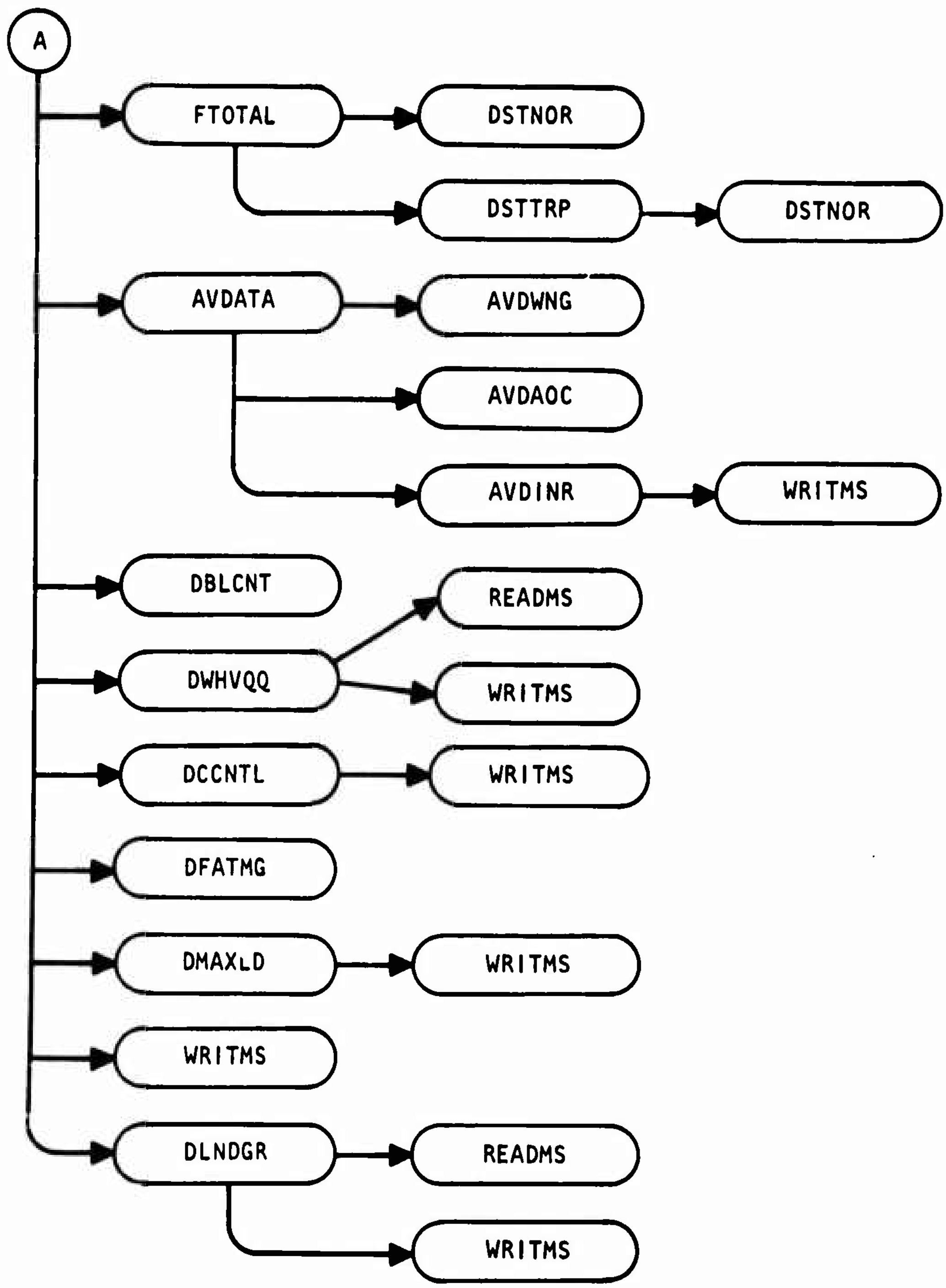


Figure 24. Data management module subroutine flow diagram (concl).

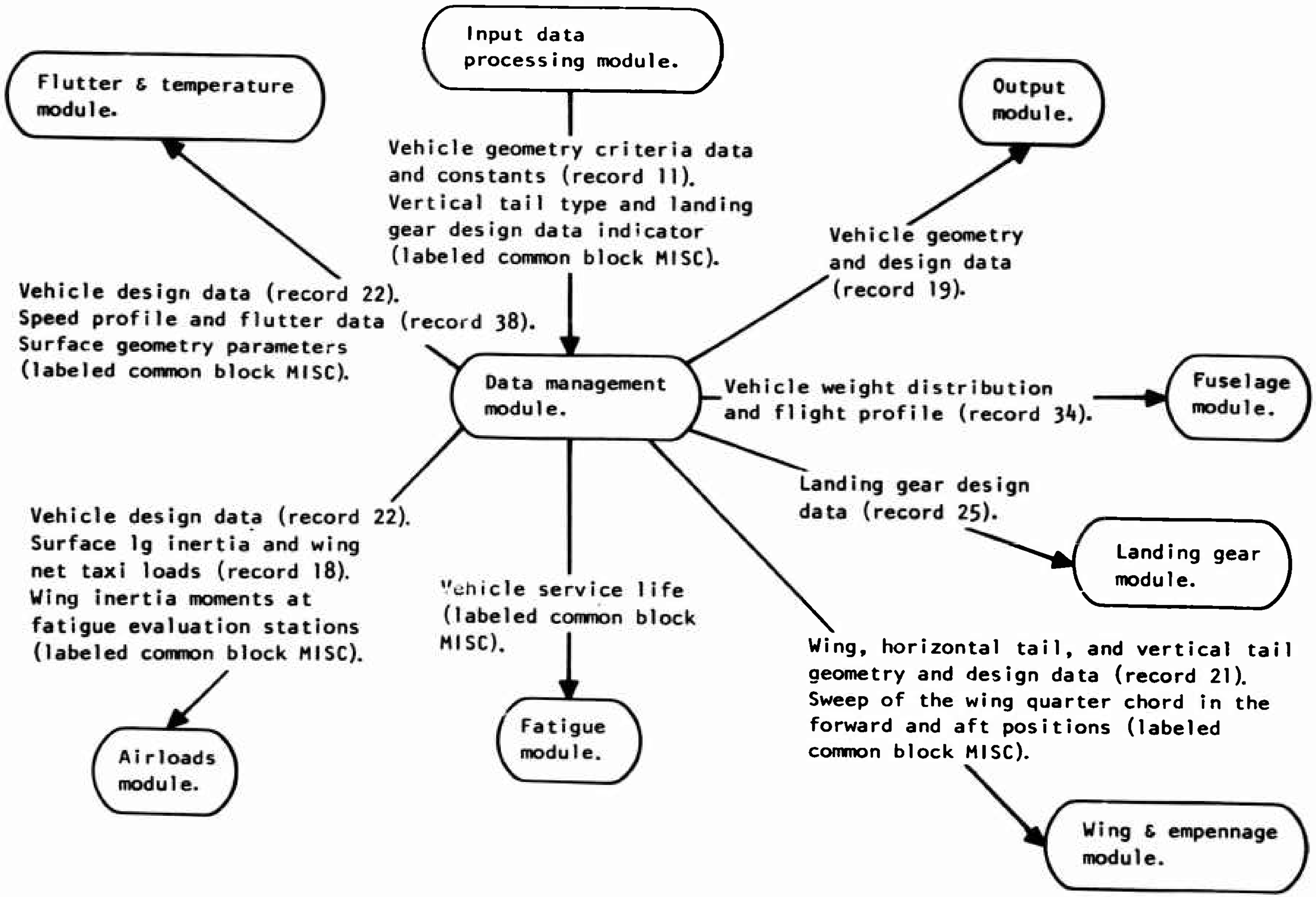


Figure 25. Flow of data from data management module to other program modules.

TABLE 24. COMMON ARRANGEMENT

Common Location	Variable Name	Description
1	D(1)	Permanent data constants (refer to Table 27)
•	•	
80	D(80)	
81	EQU(1)	Equation and physical constants (refer to Table 39)
•	•	
300	EQU(200)	
301	D(301)	Not used
•	•	
700	D(700)	
701	GDI(1)	Vehicle design indicators (refer to Table 43)
•	•	
720	GDI(20)	
721	GDD(1)	Vehicle design data (refer to Table 41)
•	•	
750	GDD(30)	
751	DATM(1)	Vehicle speed altitude profile data (refer to Table 29)
•	•	
790	DATM(40)	
791	GDWT(1)	Input weight data (refer to Table 46)
•	•	
950	GDWT(160)	
951	GDW(1)	Input wing geometry data (refer to Table 45)
•	•	
1000	GDW(50)	
1001	GDH(1)	Input horizontal tail geometry data (refer to Table 42)
•	•	
1040	GDH(40)	
1041	GDV(1)	Input vertical tail geometry data (refer to Table 44)
•	•	
1080	GDV(40)	
1081	GDB(1)	Input fuselage geometry data (refer to Table 40)
•	•	
1160	GDB(80)	
1161	DATS(1)	Input engine section and air induction system data (refer to Table 32)
•	•	
1200	DATS(40)	
1201	DATD(1)	Input inlet duct geometry data (refer to Table 28)
•	•	
1270	DATD(70)	

TABLE 24. COMMON ARRANGEMENT (CONCL)

Common Location	Variable Name	Description
1271	DATR(1)	Input two-dimensional ramp geometry data (refer to Table 31)
.	.	
1290	DATR(20)	
1291	DATN(1)	Input nacelle geometry data (refer to Table 30)
.	.	
1360	DATN(70)	
1361		Not used
.		
1400		
1401	DV(1)	Calculated variables and arrays (refer to Table 34)
.	.	
3720	DV(2320)	
3721	S(1)	Basic program scratch array (refer to individual subroutines for description of variables)
.	.	
4120	S(400)	
4121	ND(1)	Storage region for indicators and counters (refer to Table 47)
.	.	
4320	ND(200)	

TABLE 25. COMMON REGION VARIABLE LIST

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
AI	20	2781	C	Inboard engine package weight data (DVWT(251))	PRTOWE
ALOFT	1	3723	C	Altitude divided by 1,000 (S(3))	TEMPRE
ALT	10	1401	C	Altitude points on speed-altitude profile with wing fixed or aft, ft	SPDALT, DSGNPR, AVDINR, DBLCNT, DWHVQQ
ALTT	1	3724	C	Altitude, ft (S(4))	SPDALT, TEMPRE
AO	20	2821	C	Outboard engine package weight data (DVWT(301))	PRTOWE
BC	200	3521	C	Vehicle design data for use by airloads module (refer to Table 26)	DATAIN, NOSGEO, DBLCNT, DFATMG
BL	20	1931	C	Lower sector panel peripheral length at fuselage synthesis cuts, in.	FUSGEO
BLD	10	2311	C	Lower sector panel peripheral length at duct cuts, in.	DUCGEO
BLN	10	2411	C	Lower sector panel peripheral length at nacelle cuts, in.	NACGEO
BMH	11	4066	C	Horizontal tail and content 1 g inertia bending moment at weight analysis cuts, in. -lb (WLD)	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
BMV	11	4099	C	Vertical tail and content 1 g inertia bending moment at weight analysis cuts, in.-lb (WLD)	DMAXLD
BMW1	11	3868	C	Wing only 1 g inertia bending moment at wing weight-analysis cuts, wing fixed or aft, in.-lb (WLD)	DMAXLD
BMW2	11	3901	C	Wing only 1 g inertia bending moment at wing weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
BM12	11	3967	C	Wing and content 1 g inertia bending moment at BFDW at wing weight analysis cuts, wing fixed or aft, in.-lb (WLD)	DMAXLD
BM2G	11	3835	C	Wing net bending moment at 2 g taxi at weight analysis cuts, in.-lb (WLD)	DMAXLD
BM21	11	3934	C	Wing and content 1 g inertia bending moment at at MDW at wing weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
BM22	11	4000	C	Wing and content 1 g inertia bending moment at BFDW at wing weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
BM23	11	4033	C	Wing and content 1 g inertia bending moment at LDW at wing weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
BS	20	1951	C	Side sector panel peripheral length at fuselage synthesis cuts, in.	FUSGEO
BSD	10	2321	C	Side sector panel peripheral length at duct cuts, in.	DUGGEO
BSN	10	2421	C	Side sector panel peripheral length at nacelle cuts, in.	NACGEO
BU	20	1911	C	Upper sector panel peripheral length at fuselage synthesis cuts, in.	FUSGEO
BUD	10	2301	C	Upper sector panel peripheral length at duct cuts, in.	DUCGEO
BUN	10	2401	C	Upper sector panel peripheral length at nacelle cuts, in.	NACGEO
CBH	12	3821	C	Average chord of horizontal tail weight distribution segments, in. (WLD)	DMAXLD
CBV	12	3845	C	Average chord of vertical tail weight distribution segments, in. (WLD)	DMAXLD
CBW	12	2945	C	Average chord of wing weight distribution segments, in. (DVWT)	WNGDST

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
CS	10	1441	C	Speed of sound at speed profile altitude points, ft/sec	SPDALT
D	700	1	I	Permanent data constants (refer to Table 27)	All
DATD	70	1201	I	Duct geometry data (refer to Table 28)	DATAIN, DUCGEO, QUIKIE, CONDST
DATM	40	751	I	Speed-altitude profile data (refer to Table 29)	SPDALT, DBLCNT, DWHVQQ
DATN	70	1291	I	Nacelle geometry data (refer to Table 30)	DATAIN, NACGEO
DATR	20	1271	I	Ramp geometry data (refer to Table 31)	QUIKIE
DATS	40	1161	I	Engine section and air induction system input data (refer to Table 32)	DATAIN, DSGNPR, QUIKIE, WEIDST, CONDST, AVDATA, AVDAOC, AVDINR, DCCNTL, DFATMG, DMAXLD
DELX	20	1991	C	Fuselage shell segment lengths, in.	FUSGEO, NOSGEO, DSTTRI, DSTNOR, DSTTRP
DI	10	1106	I	Fuselage depth at geometry cuts, in. (GDB)	FUSGEO
DLXD	10	2331	C	Duct segment lengths, in.	DUCGEO

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
DLXN	10	2431	C	Nacelle segment lengths, in.	NACGEO
DOD	10	2291	C	Vertical flat length of duct contour, in.	DUCGEO
DON	10	2391	C	Vertical flat length of nacelle contour, in.	NACGEO
DOO	20	2051	C	Vertical flat length of fuselage contour, in.	FUSGEO
DSP	10	1711	C	Design pressure data (refer to Table 33)	DSGNPR, QUIKIE
DV	2320	1401	C	Basic calculated data region, (refer to Table 34)	All
DVB	440	1831	C	Fuselage calculated geometry data region	SPDALT, FUSGEO, QUIKIE, FUSDST, AVDATA, DSTTRI, DSTTRP, DSTNOR, NOSGEO
DVD	100	2271	C	Duct calculated geometry data region	DUCGEO, QUIKIE
DVH	30	1771	C	Horizontal tail, calculated geometry data (refer to Table 35)	WHVGEO, QUIKIE, CONDST, NOSGEO, AVDATA, DBLCNT, DCCNTL, DMAXLD
DVLG	1	781	I	General relationship between limit speed and maximum level speed (DATM)	SPDALT
DVN	150	2371	C	Nacelle calculated geometry data	NACGEO, QUIKIE, AVDATA

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
DVV	30	1801	C	Vertical tail calculated geometry data (refer to Table 36)	WHVGEO, QUIKIE, CONDST, AVDATA, DBLCNT, DCCNTL, DMAXLD
DVW	50	1721	C	Wing calculated geometry data (refer to Table 37)	WHVGEO, QUIKIE, WNGDST, CONDST, NOSGEO, DBLCNT DCCNTL, DFATMG, DMAXLD
DVWT	1000	2521	C	Basic weight distribution data array (refer to Table 38)	WHVGEO, QUIKIE, WEIDST, PRTOWE, WNGDST, FUSDST, CONDST, FTOTAL, AVDATA, AVDINR, DBLCNT, DWHVQQ, DCCNTL, DMAXLD, DFATMG, DLNDGR, AVDWNG
DWW	12	3392	C	Wing and fixed contents distributed in weight distribution segments, lb	WNGDST, DFATMG
DYW	12	2933	C	Wing weight distribution segment lengths, in.	WNGDST
EGTP	1	1162	I	Engine type (DATS) 0.0 = turbojet x.x = fanjet bypass ratio	DSGNPR
EMH	10	1501	C	Airflow at engine on M_H diagram, M	SPDALT

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
EML	10	1511	C	Airflow at engine on M_L diagram, M	SPDALT
EQU	200	81	I	Equation and physical constants (refer to Table 39)	SPDALT, TEMPRE, DSGNPR, FUSGEO, DUCGEO, NACGEO, WHVGEO, QUIKIE, WEIDST, CONDST
F	40	2621	C	Fuselage and content weights, lb (DVWT(101))	PRTOWE
G	10	1431	C	Acceleration of gravity at speed profile altitude points, ft/sec^2	SPDALT
GD	700	701	I	Input data variables (refer to DATM, GDB GDD, GDH, GDI, GDV, GDW, DATS, DATD, DATN, and DATR)	All
GDB	80	1081	I	Fuselage geometry data (refer to Table 40)	DATAIN, FUSGEO, WHVGEO, QUIKIE, FUSDST, DSTTRI, DSTTRP, NOSGEO
GDD	30	721	I	Vehicle design data (refer to Table 41)	SPDALT, QUIKIE, DBLCNT, DCCNTL, DFATMG, DMAXLD
GDH	40	1001	I	Horizontal tail geometry data (refer to Table 42)	WHVGEO, QUIKIE, AVDATA, AVDINR, AVDAOC, DWHVQQ, CDDNTL

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
GDI	20	701	I	Vehicle design indicators (refer to Table 43)	SPDALT, WHVGEO, QUIKIE, WEIDST, WNGDST, CONDST, AVDINR, DBLCNT, DCCNTL, DFATMG, DMAXLD, DWHVQQ
GDV	40	1041	I	Vertical tail geometry data (refer to Table 44)	WHVGEO, QUIKIE, AVDINR, ADVAOC, DCCNTL
GDW	50	951	I	Wing geometry data (refer to Table 45)	WHVGEO, QUIKIE, WNGDST, AVDATA, AVDINR, AVDAOC, DBLCNT, DCCNTL
GDWT	160	791	I	Weight data (refer to Table 46)	QUIKIE, WEIDST, PRTOWE, WNGDST, CONDST, FTOTAL, DCCNTL
H	10	2741	C	Horizontal tail and content weights, lb (DVWT(221))	PRTOWE
HWT	12	3392	C	Horizontal tail and content distributed in weight distribution segments, lb	DMAXLD
I	1	4221	C	Scratch counter	Most

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
IGD	1	4234	C	Inlet lip type (ND) 0 = complete section 1 = vertical lip 2 = horizontal lip	DUCGEO, QUIKIE
IGN	1	4241	C	Nacelle leading edge type (ND) 0 = complete section 1 = vertical lip 2 = horizontal lip	NACGEO, QUIKIE
II	1	4227	C	Scratch counter	WHVGEO, QUIKIE, WEIDST, WNGDST, CONDST, FTOTAL, DMAXLD
ITP	1	4231	I	Engine package type (ND) 0 = fuselage-buried engine 2 or 4 = number of nacelles	DATAIN, QUIKIE, AVDATA
IVG	1	4232	I	Inlet type (ND) 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike	DATAIN, DSGNPR, QUIKIE
J	1	4222	C	Scratch counter	Most
JJ	1	4228	C	Scratch counter	WNGDST, FTOTAL

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
K	1	4223	C	Scratch counter	Most
KC	1	4236	I	Fuselage perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	DATAIN, FUSGEO
KCD	1	4238	I	Duct perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	DATAIN, DUCGEO
KCN	1	4240	I	Nacelle perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	DATAIN, NACGEO
L	1	4224	C	Scratch counter	Most
LL	1	4230	C	Scratch counter	Most
M	1	4225	C	Scratch counter	Most
N	1	4226	C	Scratch counter	Most
NC	1	4235	I	Number of fuselage synthesis cuts (ND)	DATAIN, FUSGEO, NOSGEO, FUSDST, DSTTRP, DSTNOR, FTOTAL, AVDATA

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
NCD	1	4237	I	Number of duct cuts (ND)	DATAIN, DUCGEO, QUIKIE, CONDST
NCN	1	4239	I	Number of nacelle cuts (ND)	DATAIN, NACGEO, QUIKIE, AVDATA
ND	200	4121	C	Basic integer array (refer to Table 47)	All
PER	20	2111	C	Shell perimeter at fuselage synthesis cuts, in.	FUSGEO
PHEH	10	1671	C	Hammershock pressure at engine on M_H diagram, lb/in.^{2}	DSGNPR
PHEL	10	1691	C	Hammershock pressure at engine on M_L diagram, lb/in.^{2}	DSGNPR
PHTH	10	1661	C	Hammershock pressure at throat on M_H diagram, lb/in.^{2}	DSGNPR
PHTL	10	1681	C	Hammershock pressure at throat on M_L diagram, lb/in.^{2}	DSGNPR
PI	10	1126	I	Perimeter, inches or perimeter correction factor at fuselage geometry cuts (GDB)	FUSGEO
PO	10	1421	C	Ambient pressure at speed profile altitudes, lb/ft^2	SPDALT, DSGNPR

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
PRESH	1	3722	C	Ambient pressure, lb/ft^2 (S(2))	.SPDALT, TEMPRE
PSH	10	1581	C	Static-pressure absolute at engine on M_H diagram, $lb/in.^2$	SPDALT
PSL	10	1591	C	Static-pressure absolute at engine on M_L diagram, $lb/in.^2$	SPDALT, DSGNPR
PST	10	1701	C	Static pressure at throat on M_L diagram, $lb/in.^2$	DSGNPR
PTH	10	1561	C	Total pressure at engine on M_H diagram, $lb/in.^2$	SPDALT, DSGNPR
PTL	10	1571	C	Total pressure at engine on M_L diagram, $lb/in.^2$	SPDALT, DSGNPR
QH	10	1481	C	Dynamic pressure on M_H diagram, lb/ft^2	SPDALT, DSGNPR
QL	10	1491	C	Dynamic pressure on M_L diagram, lb/ft^2	SPDALT, DSGNPR, AVDINR
RA	35	4051	C	Weight, balance, and inertia data for fuselage-mounted nacelle package	AVDINR

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
RATG	1	782	I	General pressure recovery ratio (DATM)	SPDALT
RATH	10	1521	C	Inlet pressure recovery ratio on M_H diagram	SPDALT
RATL	10	1531	C	Inlet pressure recovery ratio on M_L diagram	SPDALT, DSGNPR
RCL	20	1871	C	Lower sector fuselage panel radius of curvature, in.	FUSGEO
RCLN	10	2461	C	Lower sector nacelle panel radius of curvature, in.	NACGEO
RCS	20	1891	C	Side sector fuselage panel radius of curvature, in.	FUSGEO
RCSN	10	2471	C	Side sector nacelle panel radius of curvature, in.	NACGEO
RCU	20	1851	C	Upper sector fuselage panel radius of curvature, in.	FUSGEO
RCUN	10	2451	C	Upper sector nacelle panel radius of curvature, in.	NACGEO
RH	35	3981	C	Weight, balance, and inertia data for horizontal tail and contents	AVDINR
RHO	10	1451	C	Density of air at speed profile altitudes, lb/ft^3	SPDALT

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
RO	20	2091	C	Corner radius of fuselage contour, in.	FUSGEO
RO	35	4086	C	Weight, balance, and inertia data for other external fuselage-mounted item (currently inactive)	AVDINR
ROD	10	2281	C	Corner radius of duct contour, in.	DUCGEO
RON	10	2381	C	Corner radius of nacelle contour, in.	NACGEO
RT	35	3911	C	Vehicle weight balance and inertia data	AVDINR
RV	35	4016	C	Weight, balance, and inertia data for vertical tail and contents	AVDINR
RW	35	3946	C	Weight, balance, and inertia data of wing and contents	AVDINR
R1H	10	1601	C	Ratio of static pressure at throat to free-stream total pressure on M_H diagram	DSGNPR
R1L	10	1611	C	Ratio of static pressure at throat to free-stream total pressure on M_L diagram	DSGNPR
R2H	10	1621	C	Ratio of hammershock pressure at engine face to total pressure on M_H diagram	DSGNPR
R2L	10	1631	C	Ratio of hammershock pressure at engine face to total pressure on M_L diagram	DSGNPR

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
R3H	10	1641	C	Ratio of hammershock pressure at throat to total pressure on M_H diagram	DSGNPR
R3L	10	1651	C	Ratio of hammershock pressure at throat to total pressure on M_L diagram	DSGNPR
S	400	3721	C	Scratch variables(refer to subroutine discussions)	All
SF	20	2011	C	Fuselage shell segment surface area, in^2.	FUSGEO, FUSDST
SFD	10	2341	C	Duct segment surface area, in^2.	DUCGEO, QUIKIE
SFN	10	2441	C	Nacelle segment surface area, in^2.	NACGEO, QUIKIE, AVDATA
SPAL	50	3721	C	Speed profile and flutter data (refer to Table 48)	DWHVQQ
STOT	1	2191	C	Total fuselage surface area, in^2. (TOT)	FUSGEO, QUIKIE, FUSDST
S1	20	2131	C	Fuselage depth at synthesis cuts, in.	FUSGEO
S2	20	2151	C	Fuselage width at synthesis cuts, in.	FUSGEO
S3	20	2171	C	Fuselage cross-section area at synthesis cuts, in^2.	FUSGEO, NOSGEO

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Name	Type	Description	Subroutine Reference
T	240	3721	C	Operational weight empty distribution table	PRTOWE
TEM	10	1411	C	Ambient temperature at speed profile altitudes, ° R	SPDALT, DSGNPR
TEMALT	1	3721	C	Ambient temperature, ° R (S(1))	SPDALT, TEMPRE
TEMH	10	1541	C	Total temperature on M_H diagram, ° R	SPDALT, DSGNPR
TEML	10	1551	C	Total temperature on M_L diagram, ° R	SPDALT, DSGNPR
TH	11	4044		Horizontal tail and content 1 g inertia torque at weight analysis cuts, in.-lb (WLD)	DMAXLD
TOT	20	2191	C	Summary data (refer to Table 49)	SPDALT, FUSGEO, QUIKIE, FUSDST
TV	11	4110	C	Vertical tail and content 1 g inertia torque at weight analysis cuts, in.-lb (WLD)	DMAXLD
TW1	11	3879	C	Wing only 1 g inertia torque at weight analysis cuts, wing fixed or aft, in.-lb (WLD)	DMAXLD
TW2	11	3912	C	Wing only 1 g inertia torque at weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
T12	11	3978	C	Wing and content 1 g inertia torque at BFDW at weight analysis cuts, wing fixed or aft, in.-lb (WLD)	DMAXLD
T2G	11	3846	C	Wing net torque at 2 g taxi at weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
T21	11	3945	C	Wing and content 1 g inertia torque at MDW at weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
T22	11	4011	C	Wing and content 1 g inertia torque at BFDW at weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
T23	11	4044	C	Wing and content 1 g inertia torque at LDW at weight analysis cuts, wing fixed or fwd, in.-lb (WLD)	DMAXLD
UIX	20	2211	C	Unit roll inertia of fuselage and contents about segment centroid, lb-in^2./lb	FUSGEO
UIXN	10	2491	C	Unit roll inertia of nacelle and contents about segment centroid, lb-in^2./lb	NACGEO
UIY	20	2231	C	Unit pitch inertia of fuselage and contents about segment centroid, lb-in2./lb	FUSGEO, AVDATA

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
UIYN	10	2501	C	Unit pitch inertia of nacelle and contents about segment centroid, lb-in^2./lb	NACGEO, AVDATA
UIZ	20	2251	C	Unit yaw inertia of fuselage and contents about segment centroid, lb-in^2./lb	FUSGEO, AVDATA
UIZN	10	2511	C	Unit yaw inertia of nacelle and contents about segment centroid, lb-in^2./lb	NACGEO, AVDATA
UX	12	2957	C	Unit roll inertia of wing and contents about segment centroid, lb-in^2./lb	WNGDST
UY	12	2969	C	Unit pitch inertia of wing and contents about segment centroid, lb-in^2./lb	WNGDST
UZ	12	2981	C	Unit yaw inertia of wing and contents about segment centroid, lb-in^2./lb	WNGDST, AVDWNG
V	10	2761	C	Vertical tail and content weight data (DVWT(241))	PRTOWE
VH	10	1461	C	Level-flight maximum speed at speed profile altitudes, M	SPDALT, DSGNPR, DBLCNT
VH	11	4055	C	Horizontal tail and content 1 g inertia shear at weight analysis cuts, lb (WLD)	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
VL	10	1471	C	Limit speed at speed profile altitudes, M	SPDALT, DSGNPR, AVDINR, DBLCNT, DWHVQQ
VOL	20	2031	C	Fuselage shell segment volume, in^3.	FUSGEO, NOSGEO
VOLT	1	2192	C	Total fuselage volume, in^3. (TOT)	FUSGEO
VV	11	4088	C	Vertical tail and content 1 g inertia shear at weight analysis cuts, lb (WLD)	DMAXLD
VWT	12	3428	C	Vertical tail and content distribution in weight distribution segments, lb	DMAXLD
VW1	11	3857	C	Wing only 1 g inertia shear at weight analysis cuts, wing fixed or aft, lb (WLD)	DMAXLD
VW2	11	3890	C	Wing only 1 g inertia shear at weight analysis cuts, wing fixed or fwd, lb (WLD)	DMAXLD
VYCG	1	3835	C	Y-centroid of vertical tail and contents, in.	AVDINR
V12	11	3956	C	Wing and content 1 g inertia shear at BFDW at weight analysis cuts, wing fixed or aft, lb (WLD)	DMAXLD
V2G	11	3824	C	Wing net shear at 2 g taxi at weight analysis cuts, wing fixed or fwd, lb (WLD)	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
V21	11	3923	C	Wing and content 1 g inertia shear at MDW at weight analysis cuts, wing fixed or fwd, lb (WLD)	DMAXLD
V22	11	3989	C	Wing and content 1 g inertia shear at BFDW at weight analysis cuts, wing fixed or fwd, lb (WLD)	DMAXLD
V23	11	4022	C	Wing and content 1 g inertia shear at LDW at weight analysis cuts, wing fixed or fwd, lb (WLD)	DMAXLD
W	10	2701	C	Wing and content weight data (DVWT(181))	PRTOWE
W	1	3846	C	Wing and content X-CG, in.	AVDAOC
WD	156	3721	C	Wing, horizontal, and vertical tail geometry and design data (refer to Table 50)	DCCNTL
WFC1	20	3301	C	Fuselage contents distribution at MDW in shell segments, lb	FTOTAL, AVDATA, AVDINR
WFC2	20	3321	C	Fuselage contents distribution at BFDW in shell segments, lb	FTOTAL, AVDATA, AVDINR
WFC3	20	3341	C	Fuselage contents distribution at LDW in shell segments, lb	FTOTAL, AVDATA, AVDINR

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
WFUS	20	2861	C	Fuselage structure distribution in shell segments, lb	FUSDST, AVDATA, AVDINR
WI	10	1116	I	Fuselage width at geometry cuts, in. (GDB)	FUSGEO
WLD	300	3821	C	Surface 1 g inertia and wing net loads data (refer to Table 51)	DMAXLD
WO	2	2071	C	Horizontal flat length of fuselage contour, in.	FUSGEO
WOD	10	2271	C	Horizontal flat length of duct contour, in.	DUCGEO
WON	10	2371	C	Horizontal flat length of nacelle contour, in.	NACGEO
WT	1	3830	C	Nacelle and contents weight, lb	AVDINR
WWT	12	2993	C	Wing structure distributed in weight distribution segments, lb	WNGDST, DMAXLD
WWT1	12	3017	C	Wing and contents at MDW distributed in weight distribution segments, lb	WNGDST, AVDWNG, DFATMG, DMAXLD
WWT2	12	3041	C	Wing and contents at BFDW distributed in weight distribution segments, lb	WNGDST, AVDWNG, DFATMG, DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
WWT3	12	3065	C	Wing and contents at LDW distributed in weight distribution segments, lb	WNGDST, AVDWNG, DFATMG, DMAXLD
X	1	3844	C	Vehicle X-CG, in.	AVDAOC
XAH	1	3831	C	Horizontal tail and content X-transfer to vehicle X-CG, in^2.	AVDAOC
XANI	1	3833	C	Inboard engine package X-transfer to vehicle X-CG, in^2.	AVDAOC
XANO	1	3834	C	Outboard engine package X-transfer to vehicle X-CG, $in.^2$	AVDAOC
XAV	1	3832	C	Vertical tail and content X-transfer to vehicle X-CG, in^2.	AVDAOC
XAW	1	3830	C	Wing and content X-transfer to vehicle X-CG, in^2.	AVDAOC
XBAR	20	1971	C	X-centroid of fuselage segments, in.	FUSGEO, FUSDST, DISTTRI, DSTTRP, DSTNOR, AVDATA
XBD	10	2351	C	X-centroid of duct segments, in.	DUCGEO, QUIKIE
XBH	12	3416	C	X-centroid of horizontal tail and content in weight distribution segments, in.	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XBN	10	2481	C	X-centroid of nacelle segments, in.	NACGEO, QUIKIE, AVDATA
XBV	12	3452	C	X-centroid of vertical tail and contents in weight distribution segments, in.	DMAXLD
XBW	12	3005	C	X-centroid of wing structure in weight distribution segments, wing in nominal position, in.	WNGDST
XBW1	12	3029	C	X-centroid of wing and contents at MDW in weight distribution segments, wing in nominal position, in.	WNGDST
XBW2	12	3053	C	X-centroid of wing and contents at BFDW in weight distribution segments, wing in nominal position, in.	WNGDST
XBW3	12	3077	C	X-centroid of wing and contents at LDW in weight distribution segments, wing in nominal position, in.	WNGDST
XB10	12	30[illegible]5	C	X-centroid of wing structure in weight distribution segments, wing fixed or aft, in.	WNGDST, DMAXLD
XB11	12	30[illegible]	C	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.	WNGDST, AVDWNG, DFATMG, DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XB12	12	3137	C	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.	WNGDST, AVDWNG, DFATMG, DMAXLD
XB13	12	3185	C	X-centroid of wing and contents of LDW in weight distribution segments, wing fixed or aft, in	WNGDST, AVDWNG, DFATMG, DMAXLD
XB20	12	2933	C	X-centroid of wing structure in weight distribution segments, wing fixed or fwd, in.	WNGDST, DMAXLD
XB21	12	3101	C	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.	WNGDST, AVDWNG, DFATMG, DMAXLD
XB22	12	3149	C	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.	WNGDST, AVDWNG, DFATMG, DMAXLD
XB23	12	3197	C	X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.	WNGDST, AVDWNG, DFATMG, DMAXLD
XCG	1	3831	C	Nacelle and contents X-CG, in.	AVDINR
XDW	12	3404	C	X-centroid of wing and fixed contents in weight distribution segments, wing in nominal position, in.	WNGDST

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XDW1	12	3416	C	X-centroid of wing and fixed contents in weight distribution segments, wing fixed or aft,in.	WNGDST, DFATMG
XDW2	12	3428	C	Y-centroid of wing and fixed contents in weight distribution segments, wing fixed or fwd, in.	WNGDST, DFATMG
XEAH	13	3782	C	X-station of horizontal tail elastic axis at weight distribution cuts, in.	DMAXLD
XEAV	13	3808	G	X-station of vertical tail elastic axis at weight distribution cuts, in.	DMAXLD
XEA1	1	2915	C	X-station of wing elastic axis at wing, synthesis cut 2 for fatigue evaluation, wing fixed or aft, in.	DFATMG
XEA2	1	2917	C	X-station of wing elastic axis at wing synthesis cut 2 for fatigue evaluation, wing fixed or fwd, in.	DFATMG
XI	10	1086	I	X-station of fuselage geometry cuts, in. (GDB)	FUSGEO, QUIKIE, FUSDST, NOSGEO, WHVGEO
XLH	12	3833	C	X-station of horizontal tail leading edge at weight distribution segment Y-centroids, in.	DMAXLD

TABLE 25. CC"ON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XLV	12	3857	C	X-station of vertical tail leading edge at weight distribution segment Z-centroids, in.	DMAXLD
XLW	12	3881	C	X-station of wing leading edge at weight distribution segment Y-centroids, wing in nominal position, in.	WNGDST
XO	20	1136	I	X-station of fuselage synthesis cuts, in. (GDB)	FUSGEO, FUSDST, DSTTRI, DSTTRP, NOSGEO
YAH	1	3835	C	Horizontal tail and content Y-transfer to vehicle center line, in^2.	AVDAOC
YANI	1	3837	C	Inboard engine package Y-transfer to vehicle center line, in^2.	AVDAOC
YANO	1	3838	C	Outboard engine package Y-transfer to vehicle center line, in^2.	AVDAOC
YAV	1	3836	C	Vertical tail and content Y-transfer to vehicle center line, in^2.	AVDAOX
YBH	12	3404	C	Y-centroid of horizontal tail weight distribution segments, in.	DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
YBW	12	2921	C	Y-centroid of wing weight distribution segments, wing in nominal position, in.	WNGDST
YB10	12	2921	C	Y-centroid of wing structure in weight distribution segments, wing fixed or aft, in.	WNGDST, DMAXLD
YB11	12	3113	C	Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.	WNGDST, AVDWNG, DMAXLD
YB12	12	3161	C	Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.	WNGDST, AVDWNG, DMAXLD
YB13	12	3209	C	Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.	WNGDST, AVDWNG, DMAXLD
YB20	12	2945	C	Y-centroid of wing structure in weight distribution segments, wing fixed or fwd, in.	WNGDST, DMAXLD
YB21	12	3125	C	Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.	WNGDST, AVDWNG, DFATMG DMAXLD
YB22	12	3173	C	Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd,in.	WNGDST, AVDWNG, DFATMG DMAXLD

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
YB23	12	3221	C	Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.	WNGDST, AVDWNG, DFATMG DMAXLD
YCG	1	3832	C	Nacelle and contents Y-CG, in.	AVDINR
YDW1	12	3440	C	Y-centroid of wing and fixed contents in weight distribution segments, wing fixed or aft, in.	WNGDST, DFATMG
YDW2	12	3452	C	Y-centroid of wing and fixed contents in weight distribution segments, wing fixed or fwd, in.	WNGDST, DFATMG
YEAH	13	3769	C	Y-station of horizontal tail elastic axis at weight distribution cuts, in.	DMAXLD
YEA1	1	2914	C	Y-station of wing elastic axis at wing synthesis cut 2 for fatigue evaluation, wing fixed or aft, in.	DFATMG
YEA2	1	2916	C	Y-station of wing elastic axis at wing synthesis cut 2 for fatigue evaluation, wing fixed or fwd, in.	DFATMG
YSF	1	1721	C	Buttock line of wing to fuselage tie, in. (DVW)	DFATMG

TABLE 25. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
YW	13	2901	C	Y-station of wing weight distribution cuts, wing in nominal position, in.	WNGDST
YY12	12	3233	C	Pitch inertia of wing and contents at BFDW in weight distribution segments, wing fixed or aft, $lb\text{-}in^2$.	WNGDST, AVDWNG
YY21	12	3257	C	Pitch inertia of wing and contents at MDW in weight distribution segments, wing fixed or fwd, $lb\text{-}in^2$.	WNGDST, AVDWNG
YY22	12	3245	C	Pitch inertia of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, $lb\text{-}in^2$.	WNGDST, AVDWNG
YY23	12	3269	C	Pitch inertia of wing and contents at LDW in weight distribution segments, wing fixed or fwd, $lb\text{-}in^2$.	WNGDST, AVDWNG
Z	1	3845	C	Vehicle Z-CG, in.	AVDAOC
ZAH	1	3840	C	Horizontal tail and content Z-transfer to vehicle Z-CG, in^2.	AVDAOC
ZANI	1	3842	C	Inboard engine package Z-transfer to vehicle Z-CG, in^2.	AVDAOC
ZANO	1	3843	C	Outboard engine package Z-transfer to vehicle Z-CG, in^2.	AVDAOC

TABLE 25. COMMON REGION VARIABLE LIST (CONCL)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ZAV	1	3841	C	Vertical tail and content Z-transfer to vehicle Z-CG, in^2.	AVDAOC
ZAW	1	3839	C	Wing and content Z-transfer to vehicle Z-CG, in^2.	AVDAOC
ZBV	12	3440	C	Z-distance from structure reference root to vertical tail weight distribution segment centroids, in.	DMAXLD
ZCG	1	3833	C	Nacelle and contents Z-CG, in.	AVDINR
ZEAV	13	3795	C	Z-distance from structure reference root to vertical tail weight distribution cuts, in.	DMAXLD
ZI	10	1096	I	Z-station of fuselage half depth at geometry cuts, in. (GDB)	FUSGEO, WHVGEO
ZO	20	1831	C	Z-station of fuselage half depth at synthesis cuts, in.	FUSGEO, AVDATA

TABLE 26. BC ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Maximum design weight (MDW), lb	DBLCNT, DFATMG
2	Vehicle X-CG with wing forward at MDW, fuselage station, in.	DBLCNT
3	Vehicle X-CG with wing aft at MDW, fuselage station, in.	DBLCNT
4	Basic flight design weight (BFDW) (MIL-A-008860A, para 6.2.1.3), lb	DBLCNT
5	Vehicle X-CG with wing forward at BFDW, fuselage station, in.	DBLCNT
6	Vehicle X-CG with wing forward at BFDW, fuselage station, in.	DBLCNT
7	Vehicle pitch inertia with wing forward at BFDW, slug-ft^2	DBLCNT
8	Vehicle pitch inertia with wing aft at BFDW, slug-ft^2	DBLCNT
9	Vehicle yaw inertia with wing forward at BFDW, slug-ft^2	DBLCNT
10	Vehicle yaw inertia with wing aft at BFDW, slug-ft^2	DBLCNT
11	Landing design weight (LDW) (MIL-A-008860A, para 6.2.1.5), lb	DBLCNT, DFATMG
12	Vehicle X-CG with wing forward at LDW, fuselage station, in.	DBLCNT
13	Positive maneuver load factor ($+N_z$) at BFDW - subsonic (MIL-A-008861A, Table 1)	DBLCNT
14	Positive maneuver load factor ($+N_z$) at BFDW - supersonic (MIL-A-008861A, Table 1)	DBLCNT

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
15	Negative maneuver load factor ($-N_z$) at BFDW (MIL-A-008861A, Table 1)	DBLCNT
16	Flaps down maneuver load factor ($+N_z$) (MIL-A-008861A, para 3.19.3)	DBLCNT
17	Pitching acceleration at M_L for BFDW rad/sec^2	DBLCNT
18	Yawing acceleration at M_L for BFDW, rad/sec^2	DBLCNT
19	Altitude at point 1 on speed profile with wing fixed or aft, ft	DBLCNT
20	Altitude at point 2 on speed profile with wing fixed or aft, ft	DBLCNT
21	Altitude at point 3 on speed profile with wing fixed or aft, ft	DBLCNT
22	Level-flight maximum speed (M_H) at altitude with wing fixed or aft, mach number	DBLCNT
23	Level-flight maximum speed (M_H) at altitude 2 with wing fixed or aft, mach number	DBLCNT
24	Level-flight maximum speed (M_H) at altitude 3 with wing fixed or aft, mach number	DBLCNT
25	Altitude at point 1 on speed profile with wing forward (var sweep only), ft	DBLCNT
26	Altitude at point 2 on speed profile with wing forward (var sweep only), ft	DBLCNT
27	Altitude at point 3 on speed profile with wing forward (var sweep only), ft	DBLCNT
28	Level-flight maximum speed (M_H) at altitude 1 with wing forward, mach number	DBLCNT
29	Level-flight maximum speed (M_H) at altitude 2 with wing forward, mach number	DBLCNT

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
30	Level-flight maximum speed (M_H) at altitude 3 with wing forward, mach number	DBLCNT
31	Minimum speed flaps up (V_{SO}) at MDW (MIL-A-008860A, para 6.2.2), knots	DBLCNT
32	Minimum speed flaps down (V_{SL}) at LDW (MIL-A-008860A, para 6.2.2), knots	DBLCNT
33	Distance for X-reference point to body nose, in.	NOSGEO
34	Length of nose, in.	NOSGEO
35	Nose volume, $in.^3$	NOSGEO
36	Equivalent maximum nose radius, in.	NOSGEO
37	Body half-width at wing-body interface, in.	DBLCNT
38	Wing leading edge sweep (wing fixed or aft), deg	DBLCNT
39	Wing reference axis sweep (wing fixed or aft), deg	DBLCNT
40	Wing leading edge apex (wing fixed or aft), fuselage station, in.	DBLCNT
41	Wing chord at apex (wing fixed or aft), in.	DBLCNT
42	Wing taper ratio (wing fixed or aft)	DBLCNT
43	Wing aspect ratio (wing fixed or aft)	DBLCNT
44	Wing area (wing fixed or aft), ft^2	DBLCNT
45	Wing span (wing fixed or aft), ft	DBLCNT
46	Wing span station 1 for weight analysis (wing fixed or aft), in.	DBLCNT
•	Outboard to	

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
56	Wing span station 11 for weight analysis (wing fixed or aft), in.	DBLCNT
57	Fraction of chord (X/C) of wing reference axis (wing fixed or aft)	DBLCNT
58	Not used	
•		
68	Not used	
69	Wing leading edge sweep (wing forward, variable sweep only), deg	DBLCNT
70	Wing reference axis sweep (wing forward, variable sweep only), deg	DBLCNT
71	Wing leading edge apex (wing forward, variable sweep only), fuselage station, in.	DBLCNT
72	Wing chord at apex (wing forward, variable sweep only), in.	DBLCNT
73	Wing taper ratio (wing forward, variable sweep only)	DBLCNT
74	Wing aspect ratio (wing forward, variable sweep only)	DBLCNT
75	Wing area (wing forward, variable sweep only), ft^2	DBLCNT
76	Wing span (wing forward, variable sweep only), ft	DBLCNT
77	Wing span station 1 for weight analysis (wing forward, variable sweep only), in.	DBLCNT
•	Outboard to	
87	Wing span station 11 for weight analysis (wing forward, variable sweep only), in.	DBLCNT

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
88	Fraction of chord (X/C) of reference axis (wing forward, variable sweep only)	DBLCNT
89	Not used	
•		
99	Not used	
100	Wing station (Y_{FI}) of inboard end of flap (wing fixed or forward), in.	DBLCNT
101	Wing station (Y_{FO}) of outboard end of flap (wing fixed or forward), in.	DBLCNT
102	Fraction of chord (C_F/C) of flap chord (wing fixed or forward)	DBLCNT
103	Required flap deflection (wing fixed or forward), deg	DBLCNT
104	Z-distance from vertical tail root to horizontal tail plane, in.	DBLCNT
105	Horizontal tail leading edge sweep, deg	DBLCNT
106	Horizontal tail reference axis sweep, deg	DBLCNT
107	Horizontal tail leading edge apex, fuselage station, in.	DBLCNT
108	Horizontal tail chord at apex, in.	DBLCNT
109	Horizontal tail taper ratio	DBLCNT
110	Horizontal tail aspect ratio	DBLCNT
111	Horizontal tail area, ft^2	DBLCNT
112	Horizontal tail span, ft	DBLCNT

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
113	Body half-width at horizontal-body interface, in.	DBLCNT
114	Horizontal tail span station 1 for weight analysis, in.	DBLCNT
•	Outboard to	
124	Horizontal tail span station 11 for weight analysis, in.	DBLCNT
125	Fraction of chord (X/C) of horizontal tail reference axis	DBLCNT
126	Not used	
•		
136	Not used	
137	Vertical tail leading edge sweep, deg	DBLCNT
138	Vertical tail reference axis sweep, deg	DBLCNT
139	Vertical tail leading edge apex, fuselage station, in.	DBLCNT
140	Vertical tail chord at apex, in.	DBLCNT
141	Vertical tail taper ratio	DBLCNT
142	Vertical tail aspect ratio	DBLCNT
143	Vertical tail area, ft^2	DBLCNT
144	Vertical tail span, ft	DBLCNT
145	Z-distance vertical tail root to vertical tail-body interface, in.	DBLCNT
146	Vertical tail span station 1 for weight analysis, in.	DBLCNT
•	Outboard to	

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
156	Vertical tail span station 11 for weight analysis, in.	DBLCNT
157	Fraction of chord (X/C) of vertical tail reference axis	DBLCNT
158	Z-coordinate of vertical tail root, in.	DBLCNT
159	Not used	
•		
162	Not used	
163	Wing lift carry-over reduction factor	DBLCNT
164	Horizontal tail lift carry-over reduction factor	DBLCNT
165	Vertical tail lift carry-over reduction factor	DBLCNT
166	Limit speed (M_L) at altitude 1 with wing fixed or aft, mach number	DBLCNT
167	Limit speed (M_L) at altitude 2 with wing fixed or aft, mach number	DBLCNT
168	Limit speed (M_L) at altitude 3 with wing fixed or aft, mach number	DBLCNT
169	Air vehicle service life, hours	DFATMG
170	Air vehicle service landings, number of landings	DFATMG
171	Unswept wing outboard station for fatigue evaluation, in.	DFATMG
172	Weight ratio 1 ($W1/W_{OF}$) for which inertia moment is calculated	DFATMG
173	Weight ratio 2 ($W2/W_{OF}$) for which inertia moment is calculated	DFATMG
174	Weight ratio 3 ($W3/W_{OF}$) for which inertia moment is calculated	DFATMG
175	Unswept moment at side of body per unit load factor, at weight ratio 1, for wing fixed or aft, in.-lb	DFATMG

TABLE 26. BC ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
176	Unswept moment at side of body per unit load factor, at weight ratio 2, for wing fixed or aft, in.-lb	DFATMG
177	Unswept moment at side of body per unit load factor, at weight ratio 3, for wing fixed or aft, in.-lb	DFATMG
178	Swept moment at outboard station per unit load factor, at weight ratio 1, for wing fixed or aft, in.-lb	DFATMG
179	Swept moment at outboard station per unit load factor, at weight ratio 2, for wing fixed or aft, in.-lb	DFATMG
180	Swept moment at outboard station per unit load factor, at weight ratio 3, for wing fixed or aft, in.-lb	DFATMG
181	Unswept moment at side of body per unit load factor, at weight ratio 1, for wing forward (variable sweep only), in.-lb	DFATMG
182	Unswept moment at side of body per unit load factor, at weight ratio 2, for wing forward (variable sweep only), in.-lb	DFATMG
183	Unswept moment at side of body per unit load factor, at weight ratio 3, for wing forward (variable sweep only), in.-lb	DFATMG
184	Swept moment at outboard station per unit load factor, at weight ratio 1, for wing forward (variable sweep only), in.-lb	DFATMG
185	Swept moment at outboard station per unit load factor, at weight ratio 2, for wing forward (variable sweep only), in.-lb	DFATMG
186	Swept moment at outboard station per unit load factor, at weight ratio 3, for wing forward (variable sweep only), in.-lb	DFATMG
187	Takeoff weight (W_{OF}) for fatigue, lb	DFATMG

TABLE 26. BC ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
188	Landing weight (W_{LF}) for fatigue, lb	DFATMG
189	Not used	
•		
200	Not used	

NOTE BC array starts at common location 3521.

TABLE 27. D-ARRAY VARIABLES

Loc	Value	Description
1	1.0	Constant
2	2.0	Constant
3	3.0	Constant
4	4.0	Constant
5	5.0	Constant
6	6.0	Constant
7	7.0	Constant
8	8.0	Constant
9	9.0	Constant
10	10.0	Constant
11	11.0	Constant
12	12.0	Constant
13	20.0	Constant
14	1000.0	Constant
15	3.1415927	Constant, PI
16	0.01745324	Constant, PI/180
17	144.0	Constant
18	24.0	Constant
19	0.5	Constant
20	1.5	Constant
21	0.333333	Constant
22	0.95	Constant
23	0.25	Constant
24	0.0	Constant
25	1.414214	Constant, square root of two
26	32.17405	Constant, acceleration of gravity
27	180.0	Constant
28	1.732051	Constant, square root of three
29	2.5	Constant
30	1.333333	Constant
31	1.5	Limit to ultimate factor for hammershock at M_H and static pressure at M_L (subroutine QUIKIE)
32	1.2	Limit to ultimate factor for hammershock at M_L (subroutine QUIKIE)
33	2.0	Taxi load factor (subroutines QUIKIE, DMAXLD)
34		Flutter speed margin (subroutine DWHVQQ)
35-80		Not used
81-280		EQU array, refer to Table 39.
281-700		Not used

NOTE: D-array starts at common location 1.

TABLE 28. DATD DUCT INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	KCD, perimeter or perimeter correction factor 1 = perimeter input 2 = perimeter correction factor input	DATAIN
2	NCD, number of cuts through duct	DATAIN
3	Not used	
•		
10	Not used	
11	X-station duct cut 1 referenced from leading edge station (loc 11 = 0.0), in.	DUCGEO, QUIKIE, CONDST
•	To	
20	X-station duct cut 10	DUCGEO, QUIKIE, CONDST
21	Y-station duct cut 1 Distance from centerline of vehicle to centerline of duct for fuselage-buried engine concept, or distance from centerline of nacelle to centerline of duct for nacelle-mounted engines.	DUCGEO
•	To	
30	Y-station duct cut 10	DUCGEO
31	Not used	
•	To	
40	Not used	
41	Duct depth at duct cut 1	DUCGEO
•	To	
50	Duct depth at duct cut 10	DUCGEO
51	Duct width at duct cut 1	DUCGEO
•	To	
60	Duct width at duct cut 10	DUCGEO
61	Duct perimeter or perimeter correction factor at duct cut 1	DUCGEO
•	To	
70	Duct perimeter or perimeter correction factor at duct cut 10	DUCGEO

NOTE DATD-array starts at common location 1201.

TABLE 29. DATM ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Level-flight maximum speed (M_H) at sea level with wing fixed or aft, M	SPDALT
•	To	
5	Level-flight maximum speed at maximum altitude with wing fixed or aft, M	SPDALT
6	Sea-level altitude with wing fixed or aft, ft	SPDALT
•	To	
10	Maximum altitude with wing fixed or aft, ft	SPDALT
11	Increment from level-flight maximum speed to limit speed (M_L) at sea level 0.0 = use general increment in location 31 <1.0 = decimal increment to add to M_H >1.0 = multiplier for M_H <0.0 = fraction of M_H to add to M_H	SPDALT
•	To	
15	Increment from level-flight maximum speed to limit speed at maximum altitude	SPDALT
16	Inlet pressure recovery ratio at M_H at sea level	SPDALT
•	To	
20	Inlet pressure recovery ratio at M_H at maximum altitude	SPDALT
21	Inlet pressure recovery ratio at M_L at sea level	SPDALT
•	To	
25	Inlet pressure recovery ratio at M_L at maximum altitude	SPDALT

TABLE 29. DATM ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
26	Airflow at engine at sea level, M	SPDALT
•	To	
30	Airflow at engine at maximum altitude, M	SPDALT
31	DVLG, general increment from level-flight speed to limit speed	SPDALT
32	RATG, general inlet pressure recovery ratio	SPDALT
33	Sea-level altitude with wing forward for variable-sweep wing vehicle only, ft	DBLCNT, DWHVQQ
	To	
35	Maximum altitude with wing forward for variable-sweep wing vehicle only, ft	DBLCNT, DWHVQQ
36	Level-flight maximum speed at sea level wing wing forward, M	DBLCNT, DWHVQQ
	To	
38	Level-flight maximum speed at maximum altitude with wing forward, M	DBLCNT, DWHVQQ
39	Cabin pressure altitude, ft	SPDALT
40	Not used	

NOTE DATM array starts at common location 751.

TABLE 30. DATN NACELLE INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	KCN, perimeter or perimeter correction factor 1 = perimeter input 2 = perimeter correction factor input	DATAIN
2	NCN, number of cuts through nacelle	DATAIN
3	Not used	
•	To	
8	Not used	
9	Nacelle maximum depth	
10	Nacelle maximum width	
11	X-station nacelle cut 1 referenced from leading edge station (loc 11 = 0.0), in. To	NACGEO
20	X-station duct cut 10	NACGEO
21	Not used	
•	To	
40	Not used	
41	Nacelle depth at nacelle cut 1	NACGEO
•	To	
50	Nacelle depth at nacelle cut 10	NACGEO
51	Nacelle width at nacelle cut 1	NACGEO
•	To	
60	Nacelle width at nacelle cut 10	NACGEO
61	Nacelle perimeter or perimeter correction factor at nacelle cut 1	NACGEO
•	To	
70	Nacelle perimeter or perimeter correction factor at nacelle cut 10	NACGEO

NOTE DATN array starts at common location 1291.

TABLE 31. DATR TWO-DIMENSIONAL RAMP INPUT
DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Number of ramps	
2	Not used	
3	Not used	
4	Length ramp 1, in.	QUIKIE
5	Length ramp 2, in.	QUIKIE
6	Length ramp 3, in.	QUIKIE
7	Length ramp 4, in.	QUIKIE
8	Width ramp 1, in.	QUIKIE
9	Width ramp 2, in.	QUIKIE
10	Width ramp 3, in.	QUIKIE
11	Width ramp 4, in.	QUIKIE
12	Not used	
•	To	
16	Not used	
17	Distance inlet leading edge to first ramp hinge, in.	QUIKIE
18	Not used	
•		
20	Not used	
NOTE	DATR array starts at common location 1271.	

TABLE 32. DATS ENGINE SECTION AND AIR INDUCTION SYSTEM INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	ITP, number of nacelles	DATAIN, QUIKIE, WEIDST, CONDST, AVDINR, DFATMG
2	EGTP, engine bypass ratio	DSGNPR
3	IVG, inlet type 1.0 = fixed duct 2.0 = fixed spike 3.0 = horizontal ramp 4.0 = vertical ramp 5.0 = translating spike 6.0 = translating and expanding spike	DATAIN
4	Capture area per inlet, $in.^2$	QUIKIE
5	Number of inlets	QUIKIE
6	Distance, leading edge of inlet to throat, in.	QUIKIE
7	Number of engines per vehicle	
8	Maximum sea-level static thrust per engine, lb	
9	Weight per engine, lb	
10	Engine length, in.	QUIKIE
11	Engine maximum diameter, in.	WEIDST
12	Distance from front face to engine center of gravity, in.	QUIKIE, WEIDST
13	X-station inlet leading edge of inboard engine package	QUIKIE, WEIDST, CONDST, AVDATA
14	Y-station inboard nacelle centerline at engine front face, in.	AVDATA, DCCNTL, DFATMG, DMAXLD
15	Z-station inboard nacelle centerline at engine front face, in.	AVDATA, AVDAOC, AVDINR, DCCNTL

TABLE 32. DATS ENGINE SECTION AND AIR INDUCTION SYSTEM INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
16	X-station inlet leading edge of outboard engine package, in.	QUIKIE, WEIDST, AVDATA
17	Y-station outboard nacelle centerline at engine front face, in.	AVDATA, DCCNTL, DFATMG, DMAXLD
18	Z-station outboard nacelle centerline at engine front face, in.	AVDATA, AVDAOC, AVDINR, DCCNTL
19	Not used	
20	Pylon, sweep of leading edge, deg	QUIKIE
21	Pylon type of mounting 0 = vertical 1 = horizontal	
22	Pylon, chord of inboard, in.	QUIKIE
23	Pylon, span of inboard, in.	QUIKIE
24	Pylon, chord of outboard, in.	QUIKIE
25	Pylon, span of outboard, in.	QUIKIE
26	Pylon, thickness to chord ratio	
27	Auxiliary inlet door area per nacelle, ft^2	
28	Duct bypass door area per nacelle, ft^2	
29	Miscellaneous door area per nacelle, ft^2	
30	Shroud indicator 0.0 = no shroud 1.0 = shroud >1.0 = shroud area, ft^2	
31 • 40	Not used To Not used	

NOTE DATS array starts at common location 1161.

TABLE 32. DATS ENGINE SECTION AND AIR INDUCTION SYSTEM INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	ITP, number of nacelles	DATAIN, QUIKIE, WEIDST, CONDST, AVDINR, DFATMG
2	EGTP, engine bypass ratio	DSGNPR
3	IVG, inlet type 1.0 = fixed duct 2.0 = fixed spike 3.0 = horizontal ramp 4.0 = vertical ramp 5.0 = translating spike 6.0 = translating and expanding spike	DATAIN
4	Capture area per inlet, $in.^2$	QUIKIE
5	Number of inlets	QUIKIE
6	Distance, leading edge of inlet to throat, in.	QUIKIE
7	Number of engines per vehicle	
8	Maximum sea-level static thrust per engine, lb	
9	Weight per engine, lb	
10	Engine length, in.	QUIKIE
11	Engine maximum diameter, in.	WEIDST
12	Distance from front face to engine center of gravity, in.	QUIKIE, WEIDST
13	X-station inlet leading edge of inboard engine package	QUIKIE, WEIDST, CONDST, AVDATA
14	Y-station inboard nacelle centerline at engine front face, in.	AVDATA, DCCNTL, DFATMG, DMAXLD
15	Z-station inboard nacelle centerline at engine front face, in.	AVDATA, AVDAOC, AVDINR, DCCNTL

TABLE 33. DSP VARIABLE-DATA ARRAYS

Loc	Description	Subroutine Reference
1	Altitude at maximum dynamic pressure on maximum limit speed flight profile, ft	DSGNPR
2	Level-flight speed at maximum dynamic pressure, M	DSGNPR
3	Limit speed at maximum dynamic pressure, M	DSGNPR
4	Maximum dynamic pressure on maximum level flight profile, lb/ft^2	DSGNPR
5	Maximum dynamic pressure on limit speed flight profile, lb/ft^2	DSGNPR, QUIKIE, DCCNTL
6	Maximum hammershock pressure absolute at inlet throat on maximum level-flight profile, psia	DSGNPR, QUIKIE
7	Maximum hammershock pressure absolute at inlet throat on limit speed flight profile, psia	DSGNPR, QUIKIE
8	Maximum static pressure at engine on limit speed flight profile, psig	DSGNPR, QUIKIE
9	Maximum hammershock pressure at engine on maximum level-speed flight profile, psig	DSGNPR, QUIKIE
10	Maximum hammershock pressure at engine on limit speed flight profile, psig	DSGNPR, QUIKIE

NOTE DSP array starts at common location 1711.

TABLE 34. DV ARRAY REGION GENERAL MAP

DV Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
1 - 10	ALT(1) - ALT(10)		25
11 - 20	TEM(1) - TEM(10)		25
21 - 30	PO(1) - PO(10)		25
31 - 40	G(1) - G(10)		25
41 - 50	CS(1) - CS(10)		25
51 - 60	RHO(1) - RHO(10)		25
61 - 70	VH(1) - VH(10)		25
71 - 80	VL(1) - VL(10)		25
81 - 90	QH(1) - QH(10)		25
91 - 100	QL(1) - QL(10)		25
101 - 110	EMH(1) - EMH(10)		25
111 - 120	EML(1) - EML(10)		25
121 - 130	RATH(1) - RATH(10)		25
131 - 140	RATL(1) - RATL(10)		25
141 - 150	TEMH(1) - TEMH(10)		25
151 - 160	TEML(1) - TEML(10)		25
161 - 170	PTH(1) - PTH(10)		25
171 - 180	PTL(1) - PTL(10)		25
181 - 190	PSH(1) - PSH(10)		25
191 - 200	PSL(1) - PSL(10)		25
201 - 210	R1H(1) - R1H(10)		25
211 - 220	R1L(1) - R1L(10)		25
221 - 230	R2H(1) - R2H(10)		25
231 - 240	R2L(1) - R2L(10)		25
241 - 250	R3H(1) - R3H(10)		25
251 - 260	R3L(1) - R3L(10)		25
261 - 270	PHTH(1) - PHTH(10)		25
271 - 280	PHEH(1) - PHEH(10)		25
281 - 290	PHTL(1) - PHTL(10)		25
291 - 300	PHEL(1) - PHEL(10)		25
301 - 310	PST(1) - PST(10)		25
311 - 320	DSP(1) - DSP(10)		33
321 - 370	DVW(1) - DVW(50)		37
371 - 400	DVH(1) - DVH(30)		35
401 - 430	DVV(1) - DVV(30)		36
431 - 450	DVB(1) - DVB(20)	ZO(1) - ZO(20)	25
451 - 470	DVB(21) - DVB(40)	RCU(1) - RCU(20)	25
471 - 490	DVB(41) - DVB(60)	RCL(1) - RCL(20)	25
491 - 510	DVB(61) - DVB(80)	RCS(1) - RCS(20)	25
511 - 530	DVB(81) - DVB(100)	BU(1) - BU(20)	25

TABLE 34. DV ARRAY REGION GENERAL MAP (CONT)

DV Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
531 - 550	DVB(101) - DVB(120)	BL(1) - BL(20)	25
551 - 570	DVB(121) - DVB(140)	BS(1) - BS(20)	25
571 - 590	DVB(141) - DVB(160)	XBAR(1) - XBAR(20)	25
591 - 610	DVB(161) - DVB(180)	DELX(1) - DELX(20)	25
611 - 630	DVB(181) - DVB(200)	SF(1) - SF(20)	25
631 - 650	DVB(201) - DVB(220)	VOL(1) - VOL(20)	25
651 - 670	DVB(221) - DVB(240)	DOO(1) - DOO(20)	25
671 - 690	DVB(241) - DVB(260)	WO(1) - WO(20)	25
691 - 710	DVB(261) - DVB(280)	RO(1) - RO(20)	25
711 - 730	DVB(281) - DVB(300)	PER(1) - PER(20)	25
731 - 750	DVB(301) - DVB(320)	S1(1) - S1(20)	25
751 - 770	DVB(321) - DVB(340)	S2(1) - S2(20)	25
771 - 790	DVB(341) - DVB(360)	S3(1) - S3(20)	25
791 - 810	DVB(361) - DVB(380)	TOT(1) - TOT(20)	49
811 - 830	DVB(381) - DVB(400)	UIX(1) - UIX(20)	25
831 - 850	DVB(401) - DVB(420)	UIY(1) - UIY(20)	25
851 - 870	DVB(421) - DVB(440)	UIZ(1) - UIZ(20)	25
871 - 880	DVD(1) - DVD(10)	WOD(1) - WOD(10)	25
881 - 890	DVD(11) - DVD(30)	ROD(1) - ROD(10)	25
891 - 900	DVD(21) - DVD(30)	DOD(1) - DOD(10)	25
901 - 910	DVD(31) - DVD(40)	BUD(1) - BUD(10)	25
911 - 920	DVD(41) - DVD(50)	BLD(1) - BLD(10)	25
921 - 930	DVD(51) - DVD(60)	BSD(1) - BSD(10)	25
931 - 940	DVD(61) - DVD(70)	DLXD(1) - DLXD(10)	25
941 - 950	DVD(71) - DVD(80)	SFD(1) - SFD(10)	25
951 - 960	DVD(81) - DVD(90)	XBD(1) - XBD(10)	25
961 - 970	DVD(91) - DVD(100)		
971 - 980	DVN(1) - DVN(10)	WON(1) - WON(10)	25
981 - 990	DVN(11) - DVN(20)	RON(1) - RON(10)	25
991 - 1000	DVN(21) - DVN(30)	DON(1) - DON(10)	25
1001 - 1010	DVN(31) - DVN(40)	BUN(1) - BUN(10)	25
1011 - 1020	DVN(41) - DVN(50)	BLN(1) - BLN(10)	25
1021 - 1030	DVN(51) - DVN(60)	BSN(1) - BSN(10)	25
1031 - 1040	DVN(61) - DVN(70)	DLXN(1) - DLXN(10)	25
1041 - 1050	DVN(71) - DVN(80)	SFN(1) - SFN(10)	25
1051 - 1060	DVN(81) - DVN(90)	RCUN(1) - RCUN(10)	25
1061 - 1070	DVN(91) - DVN(100)	RCLN(1) - RCLN(10)	25
1071 - 1080	DVN(101) - DVN(110)	RCSN(1) - RCSN(10)	25
1081 - 1090	DVN(111) - DVN(120)	XSBN(1) - XBN(10)	25
1091 - 1100	DVN(121) - DVN(130)	UIXN(1) - UIXN(10)	25

TABLE 34. DV ARRAY REGION GENERAL MAP (CONT)

DV Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
1101 - 1110	DVN(131) - DVN(140)	UIYN(1) - UIYN(10)	25
1111 - 1120	DVN(141) - DVN(150)	UIZN(1) - UIZN(10)	25
1121 - 1460	DVWT(1) - DVWT(340)		38
1461 - 1480	DVWT(341) - DVWT(360)	WFUS(1) - WFUS(20)	25
1481 - 1501	DVWT(361) - DVWT(380)		38
1501 - 1513	DVWT(381) - DVWT(393)	YW(1) - YW(13)	25
1514 - 1520	DVWT(394) - DVWT(400)		38
1521 - 1532	DVWT(401) - DVWT(412)	YB10(1) - YB10(12)	(Also YBW) 25
1533 - 1544	DVWT(413) - DVWT(424)	XB20(1) - XB20(12)	(Also DYW) 25
1545 - 1556	DVWT(425) - DVWT(436)	YB20(1) - YB20(12)	(Also CBW) 25
1557 - 1568	DVWT(437) - DVWT(448)	UX(1) - UX(12)	25
1569 - 1580	DVWT(449) - DVWT(460)	UY(1) - UY(12)	25
1581 - 1592	DVWT(461) - DVWT(472)	UZ(1) - UZ(12)	25
1593 - 1604	DVWT(473) - DVWT(484)	WWT(1) - WWT(12)	25
1605 - 1616	DVWT(485) - DVWT(496)	XB10(1) - XB10(12)	(Also XBW) 25
1617 - 1628	DVWT(497) - DVWT(508)	WWT1(1) - WWT1(12)	25
1629 - 1640	DVWT(509) - DVWT(520)	XBW1(1) - XBW1(12)	25
1641 - 1652	DVWT(521) - DVWT(532)	WWT2(1) - WWT2(12)	25
1653 - 1664	DVWT(533) - DVWT(544)	XBW2(1) - XBW2(12)	25
1665 - 1676	DVWT(545) - DVWT(556)	WWT3(1) - WWT3(12)	25
1677 - 1688	DVWT(557) - DVWT(568)	XBW3(1) - XBW3(12)	25
1689 - 1700	DVWT(569) - DVWT(580)	XB11(1) - XB11(12)	25
1701 - 1712	DVWT(581) - DVWT(592)	XB21(1) - XB21(12)	25
1713 - 1724	DVWT(593) - DVWT(604)	YB11(1) - YB11(12)	25
1725 - 1736	DVWT(605) - DVWT(616)	YB21(1) - YB21(12)	25
1737 - 1748	DVWT(617) - DVWT(628)	XB12(1) - XB12(12)	25
1749 - 1760	DVWT(629) - DVWT(640)	XB22(1) - XB22(12)	25
1761 - 1772	DVWT(641) - DVWT(652)	YB12(1) - YB12(12)	25
1773 - 1784	DVWT(653) - DVWT(664)	YB22(1) - YB22(12)	25
1785 - 1796	DVWT(665) - DVWT(676)	XB13(1) - XB13(12)	25
1797 - 1808	DVWT(677) - DVWT(688)	XB23(1) - XB23(12)	25
1809 - 1820	DVWT(689) - DVWT(700)	YB13(1) - YB13(12)	25
1821 - 1832	DVWT(701) - DVWT(712)	YB23(1) - YB23(12)	25
1833 - 1844	DVWT(713) - DVWT(724)	YY12(1) - YY12(12)	25
1845 - 1856	DVWT(725) - DVWT(736)	YY22(1) - YY22(12)	25
1857 - 1868	DVWT(737) - DVWT(748)	YY21(1) - YY21(12)	25
1869 - 1880	DVWT(749) - DVWT(760)	YY23(1) - YY23(12)	25
1881 - 1900	DVWT(761) - DVWT(780)		Not used
1901 - 1920	DVWT(781) - DVWT(800)	WFC1(1) - WFC1(20)	25
1921 - 1940	DVWT(801) - DVWT(820)	WFC2(1) - WFC2(20)	25

TABLE 34. DV ARRAY REGION GENERAL MAP (CONCL)

DV Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
1941 - 1960	DVWT(821) - DVWT(840)	WFC3(1) - WFC3(20)	25
1961 - 1980	DVWT(841) - DVWT(860)		38
1981 - 1991	DVWT(861) - DVWT(871)		38
1992 - 2003	DVWT(872) - DVWT(883)	HWT(1) - HWT(12)	(Also DWW) 25
2004 - 2015	DVWT(884) - DVWT(895)	YBH(1) - YBH(12)	(Also XDW) 25
2016 - 2027	DVWT(896) - DVWT(907)	XBH(1) - XBH(12)	(Also XDW1) 25
2028 - 2039	DVWT(908) - DVWT(919)	VWT(1) - VWT(12)	(Also XDW2) 25
2040 - 2051	DVWT(920) - DVWT(931)	ZBV(1) - ZBV(12)	(Also YDW1) 25
2052 - 2063	DVWT(932) - DVWT(943)	XBV(1) - XBV(12)	(Also YDW2) 25
2064 - 2120	DVWT(944) - DVWT(1000)		38
2121 - 2320	BC(1) - BC(200)		26

NOTE DV array starts at common location 1401.

TABLE 35. DVH HORIZONTAL TAIL CALCULATED DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Distance from vertical tail root to horizontal tail reference plane, in.	WHVGEO, DBLCNT
2	Sweep of leading edge, deg	WHVGEO, DBLCNT, DCCNTL, DMAXLD
3	Sweep of elastic axis, deg	WHVGEO, DBLCNT, DMAXLD
4	X-station of leading edge apex, in.	WHVGEO, NOSGEO, DBLCNT, DCCNTL, DMAXLD
5	Root chord, in.	WHVGEO, AVDATA, DBLCNT, DMAXLD
6	Taper ratio	WHVGEO, QUIKIE, AVDATA, DBLCNT, DCCNTL, DMAXLD
7	Aspect ratio	WHVGEO, QUIKIE, DBLCNT, DCCNTL
8	Horizontal tail planform area, ft^2	WHVGEO, QUIKIE, DBLCNT, DCCNTL
9	Span, ft	WHVGEO, AVDATA, DBLCNT
10	Buttock line of horizontal tail to fuselage tie, in.	WHVGEO, AVDATA, DBLCNT, DCCNTL
11	Y-station at synthesis cut 1, in.	WHVGEO, AVDATA, DBLCNT, DCCNTL, DMAXLD
.	To	
21	Y-station at synthesis cut 11, in.	WHVGEO, AVDATA, DBLCNT, DCCNTL, DMAXLD
22	Structural elastic axis location, fraction of total chord	WHVGEO, DBLCNT, DCCNTL, DMAXLD
23	Sweep of quarter chord, deg	WHVGEO, QUIKIE
24	X-station of quarter chord at mean aerodynamic chord (based on exposed geometry for spindle mounted tails), in.	WHVGEO, QUIKIE, CONDST
25	Mean aerodynamic chord (based on exposed geometry for spindle mounted tails), in.	WHVGEO, QUIKIE
26	X-station of quarter chord at mean aerodynamic chord, in.	WHVGEO
27	Mean aerodynamic chord, in.	WHVGEO
28	Not used	
.		
30	Not used	

NOTE DVH array starts at common location 1771.

TABLE 36. DVV VERTICAL TAIL CALCULATED DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Sweep of leading edge, deg	WHVGEO, DBLCNT, DMAXLD
2	Sweep of elastic axis, deg	WHVGEO, DBLCNT, DMAXLD
3	X-station of leading edge apex (load reference geometry), in.	WHVGEO, DBLCNT, DCCNTL, DMAXLD
4	Root chord (load reference geometry), in.	WHVGEO, AVDATA, DBLCNT, DMAXLD
5	Taper ratio (load reference geometry), in.	WHVGEO, AVDATA, DBLCNT, DMAXLD
6	Aspect ratio (load reference geometry)	WHVGEO, DBLCNT
7	Vertical fail planform area (load reference geometry), ft^2	WHVGEO, DBLCNT
8	Span (load reference geometry), ft	WHVGEO, AVDATA, DBLCNT, DMAXLD
9	Distance from load reference root to structural reference root, in.	WHVGEO, AVDATA, DBLCNT, DCCNTL, DMAXLD
10	Z-distance from load reference root at synthesis cut 1, in.	WHVGEO, DBLCNT, DCCNTL, DMAXLD
.	To	
20	Z-distance from load reference root at synthesis cut 11, in.	WHVGEO, DBLCNT, DCCNTL, DMAXLD
21	Structural elastic axis location, fraction of total chord	WHVGEO, DBLCNT, DMAXLD
22	Sweep of quarter chord, deg	WHVGEO, QUIKIE
23	Number of vertical tails	WHVGEO, QUIKIE, DCCNTL, DMAXLD
24	X-station of quarter chord at mean aerodynamic chord (structure reference geometry), in.	WHVGEO, QUIKIE, CONDST
25	Mean aerodynamic chord (structure reference geometry), in.	WHVGEO, QUIKIE
26	Z-station of vertical tail load reference root, in.	WHVGEO, AVDATA, DBLCNT
27	Z-station of vertical tail tip, in.	WHVGEO
28	X-station of trailing edge at tip, in.	WHVGEO
29	Span (Structure reference geometry), ft	WHVGEO
30	Root chord (structure reference geometry), in.	WHVGEO

NOTE DVV array starts of common location 1801.

TABLE 37. DVW WING CALCULATED DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Buttock line of wing to fuselage tie, in.	WHVGEO, DBLCNT
2	Sweep of leading edge (fixed or aft), deg.	WHVGEO, DBLCNT
3	Sweep of elastic axis (fixed or aft), deg	WHVGEO, DBLCNT, DFATMG, DMAXLD
4	X-station of leading edge apex (fixed or aft), in.	WHVGEO, DBLCNT, DMAXLD
5	Root chord (fixed or aft), in.	WHVGEO, DBLCNT, DMAXLD
6	Taper ratio (fixed or aft)	WHVGEO, DBLCNT
7	Aspect ratio (fixed or aft)	WHVGEO, DBLCNT
8	Wing area (fixed or aft), ft^2	WHVGEO, DBLCNT
9	Span (fixed or aft), ft	WHVGEO, DBLCNT
10	Y-station at synthesis cut 1 (fixed or aft), in.	WHVGEO, DBLCNT, DMAXLD
..	To	
20	Y-station at synthesis cut 11 (fixed or aft), in.	WHVGEO, DBLCNT, DMAXLD
21	Structural elastic axis location, fraction of total chord (fixed or aft)	WHVGEO, DBLCNT, DMAXLD
22	Sweep of leading edge (fwd), deg	WHVGEO, DBLCNT
23	Sweep of elastic axis (fwd), deg	WHVGEO, DBLCNT, DFATMG, DMAXLD
24	X-station of leading edge apex (fwd), in.	WHVGEO, DBLCNT, DMAXLD
25	Root chord (fwd), in.	WHVGEO, DBLCNT, DMAXLD
26	Taper ratio (fwd)	WHVGEO, DBLCNT
27	Aspect ratio (fwd)	WHVGEO, DBLCNT
28	Wing area (fwd), ft^2	WHVGEO, DBLCNT
29	Span (fwd), ft	WHVGEO, DBLCNT
30	Y-station at synthesis cut 1 (fwd), in.	WHVGEO, DBLCNT, DMAXLD
.	To	
40	Y-station at synthesis cut 11 (fwd), in.	WHVGEO, DBLCNT, DMAXLD
41	Structural elastic axis location, fraction of total chord (fwd)	WHVGEO, DBLCNT, DMAXLD
42	Sweep of 50-percent chord (nominal), deg	WHVGEO
43	X-station of quarter chord at mean aerodynamic chord (nominal), in.	WHVGEO, QUIKIE, CONDST
44	Mean aerodynamic chord (nominal), in.	WHVGEO, QUIKIE
45	Semispan (nominal), in.	WHVGEO, QUIKIE, WNGDST
46	Sweep of leading edge (nominal), deg	WHVGEO, WNGDST, DCCNTL
47	X-station of leading edge apex (nominal), in.	WHVGEO, NOSGEO, WNGDST, DCCNTL

TABLE 37. DVW WING CALCULATED DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
48	Root chord (nominal), in.	WHVGEO, WNGDST
49	Tip chord (nominal), in.	WHVGEO, WNGDST
50	Sweep of quarter chord (nominal), deg	WHVGEO, QUIKIE

NOTE DVW array starts at common location 1721.

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Wing weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
2	Horizontal tail weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
3	Vertical tail weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
4	Fuselage weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
5	Main landing gear weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
6	Nose landing gear weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
7	Surface controls weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
8	Engine section and nacelle weight, lb	QUIKIE, PRTOWE, DFATMG
9	Other structure weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
10	Engine weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
11	Auxiliary gearboxes and drive weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
12	Air induction system structure weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
13	Air induction system actuators and controls weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
14	Exhaust system weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
15	Cooling and drains weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
16	Lubrication system weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
17	Fuel system weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
18	Engine controls weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
19	Starting system weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
20	Auxiliary power unit weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
21	Instruments weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
22	Hydraulics weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
23	Electrical weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
24	Electronics weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
25	Armament weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
26	Furnishings weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
27	Air conditioning and anti-icing weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
28	Photographic weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
29	Auxiliary gear weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
30	Other item weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
31	Crew weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
32	Trapped fuel weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
33	Oil weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
34	Liquid nitrogen weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
35	Miscellaneous weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
36	Guns weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
37	Wing pylons weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
38	Wing external tanks weight, lb	QUIKIE, WEIDST, PRTOWE, DFTAMG
39	Fuselage pylons weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
40	Fuselage external fuel tank weight, lb	QUIKIE, WEIDST, PRTOWE, DFATMG
41	Fuselage payload at BFDW, lb	QUIKIE, PRTOWE
42	Wing payload at BFDW, lb	QUIKIE, PRTOWE
43	Ammunition at BFDW, lb	QUIKIE, PRTOWE
44	Fuel, wing tank 1 at BFDW, lb	QUIKIE, PRTOWE, DCCNTL
45	Fuel, wing tank 2 at BFDW, lb	QUIKIE, PRTOWE, DCCNTL
46	Fuel, fuselage tank 1 at BFDW, lb	QUIKIE, PRTOWE
47	Fuel, fuselage tank 2 at BFDW, lb	QUIKIE, PRTOWE
48	Fuel, fuselage tank 3 at BFDW, lb	QUIKIE, PRTOWE
49	Fuel, fuselage tank 4 at BFDW, lb	QUIKIE, PRTOWE
50	Fuel, fuselage tank 5 at BFDW, lb	QUIKIE, PRTOWE
51	X-CG wing, in.	QUIKIE, WEIDST, PRTOWE
52	X-CG horizontal tail, in.	QUIKIE, WEIDST, PRTOWE
53	X-CG vertical tail, in.	QUIKIE, WEIDST, PRTOWE
54	X-CG fuselage, in.	QUIKIE, WEIDST, PRTOWE
55	X-CG main landing gear, in.	QUIKIE, WEIDST, PRTOWE
56	X-CG nose landing gear, in.	QUIKIE, WEIDST, PRTOWE
57	X-CG surface controls, in.	QUIKIE, WEIDST, PRTOWE
58	X-CG engine section and nacelles, in.	QUIKIE, WEIDST, PRTOWE
59	X-CG other structure, in.	QUIKIE, WEIDST, PRTOWE
60	X-CG engines, in.	QUIKIE, WEIDST, PRTOWE
61	X-CG auxiliary gearboxes and drives, in.	QUIKIE, WEIDST, PRTOWE
62	X-CG air induction system structure, in.	QUIKIE, WEIDST, PRTOWE
63	X-CG air induction system actuators and controls, in.	QUIKIE, WEIDST, PRTOWE
64	X-CG exhaust system, in.	QUIKIE, WEIDST, PRTOWE
65	X-CG cooling and drains, in.	QUIKIE, WEIDST, PRTOWE
66	X-CG lubrication system, in.	QUIKIE, WEIDST, PRTOWE
67	X-CG fuel system, in.	QUIKIE, WEIDST, PRTOWE
68	X-CG engine controls, in.	QUIKIE, WEIDST, PRTOWE
69	X-CG starting system, in.	QUIKIE, WEIDST, PRTOWE
70	X-CG auxiliary power unit, in.	QUIKIE, WEIDST, PRTOWE

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
71	X-CG instruments, in.	QUIKIE, WEIDST, PRTOWE
72	X-CG hydraulics, in.	QUIKIE, WEIDST, PRTOWE
73	X-CG electrical, in.	QUIKIE, WEIDST, PRTOWE
74	X-CG electronics, in.	QUIKIE, WEIDST, PRTOWE
75	X-CG armament, in.	QUIKIE, WEIDST, PRTOWE
76	X-CG furnishings, in.	QUIKIE, WEIDST, PRTOWE
77	X-CG air conditioning and anti-icing, in.	QUIKIE, WEIDST, PRTOWE
78	X-CG photographic, in.	QUIKIE, WEIDST, PRTOWE
79	X-CG auxiliary gear, in.	QUIKIE, WEIDST, PRTOWE
80	X-CG other items, in.	QUIKIE, WEIDST, PRTOWE
81	X-CG crew, in.	QUIKIE, WEIDST, PRTOWE
82	X-CG trapped fuel, in.	QUIKIE, WEIDST, PRTOWE
83	X-CG oil, in.	QUIKIE, WEIDST, PRTOWE
84	X-CG liquid nitrogen, in.	QUIKIE, WEIDST, PRTOWE
85	X-CG miscellaneous, in.	QUIKIE, WEIDST, PRTOWE
86	X-CG guns, in.	QUIKIE, WEIDST, PRTOWE
87	X-CG wing pylons, in.	QUIKIE, WEIDST, PRTOWE
88	X-CG wing external tanks, in.	QUIKIE, WEIDST, PRTOWE
89	X-CG fuselage pylons, in.	QUIKIE, WEIDST, PRTOWE
90	X-CG fuselage external tanks, in.	QUIKIE, WEIDST, PRTOWE
91	X-CG fuselage payload, in.	QUIKIE, PRTOWE
92	X-CG wing payload, in.	QUIKIE, PRTOWE
93	X-CG ammunition, in.	QUIKIE, PRTOWE
94	X-CG fuel, wing tank 1, in.	QUIKIE, PRTOWE
95	X-CG fuel, wing tank 2, in.	QUIKIE, PRTOWE
96	X-CG fuel, fuselage tank 1, in.	QUIKIE, PRTOWE
97	X-CG fuel, fuselage tank 2, in.	QUIKIE, PRTOWE
98	X-CG fuel, fuselage tank 3, in.	QUIKIE, PRTOWE
99	X-CG fuel, fuselage tank 4, in.	QUIKIE, PRTOWE
100	X-CG fuel, fuselage tank 5, in.	QUIKIE, PRTOWE
Locations 101 through 180 contain fuselage and content weight data		
101	Fuselage weight, lb	WEIDST, PRTOWE, FUSDST
102	Main landing gear weight, lb	WEIDST, PRTOWE, CONDST
103	Nose landing gear weight, lb	WEIDST, PRTOWE, CONDST
104	Cockpit items of surface controls weight, lb	WEIDST, PRTOWE, CONDST
105	Distributed surface controls weight, lb	WEIDST, PRTOWE, CONDST

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
106	Other structure weight, lb	WEIDST, PRTOWE, CONDST
107	Fuel system weight, lb	WEIDST, PRTOWE, CONDST
108	Engine controls weight, lb	WEIDST, PRTOWE, CONDST
109	Auxiliary power unit weight, lb	WEIDST, PRTOWE, CONDST
110	Instruments weight, lb	WEIDST, PRTOWE, CONDST
111	Hydraulics weight, lb	WEIDST, PRTOWE, CONDST
112	Electrical weight, lb	WEIDST, PRTOWE, CONDST
113	Electronics weight, lb	WEIDST, PRTOWE, CONDST
114	Armament weight, lb	WEIDST, PRTOWE, CONDST
115	Furnishings weight, lb	WEIDST, PRTOWE, CONDST
116	Air conditioning and anti-icing weight, lb	WEIDST, PRTOWE, CONDST
117	Photographic weight, lb	WEIDST, PRTOWE, CONDST
118	Auxiliary gear weight, lb	WEIDST, PRTOWE, CONDST
119	Other equipment weight, lb	WEIDST, PRTOWE, CONDST
120	Crew weight, lb	WEIDST, PRTOWE, CONDST
121	Trapped fuel weight, lb	WEIDST, PRTOWE, CONDST
122	Liquid nitrogen weight, lb	WEIDST, PRTOWE, CONDST
123	Miscellaneous weight, lb	WEIDST, PRTOWE, CONDST
124	Guns weight, lb	WEIDST, PRTOWE, CONDST
125	Fuselage pylons weight, lb	WEIDST, PRTOWE, CONDST
126	Fuselage external tanks weight, lb	WEIDST, PRTOWE, CONDST
127	Not used	
.		
140	Not used	
141	X-CG fuselage, in.	WEIDST, FUSDST
142	X-CG main landing gear, in.	WEIDST, CONDST
143	X-CG nose landing gear, in.	WEIDST, CONDST
144	X-CG cockpit items of surface controls, in.	WEIDST, CONDST
145	X-CG distributed surface controls, in.	WEIDST, CONDST
146	X-CG other structure, in.	WEIDST, CONDST
147	X-CG fuel system, in.	WEIDST, CONDST
148	X-CG engine controls, in.	WEIDST, CONDST
149	X-CG auxiliary power unit, in.	WEIDST, CONDST
150	X-CG instruments, in.	WEIDST, CONDST
151	X-CG hydraulics, in.	WEIDST, CONDST
152	X-CG electrical, in.	WEIDST, CONDST
153	X-CG electronics, in.	WEIDST, CONDST

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
154	X-CG armament, in.	WEIDST, CONDST
155	X-CG furnishings, in.	WEIDST, CONDST
156	X-CG air conditioning and anti-icing, in.	WEIDST, CONDST
157	X-CG photographic, in.	WEIDST, CONDST
158	X-CG auxiliary gear, in.	WEIDST, CONDST
159	X-CG other equipment, in.	WEIDST, CONDST
160	X-CG crew, in.	WEIDST, CONDST
161	X-CG trapped fuel, in.	WEIDST, CONDST
162	X-CG liquid nitrogen, in.	WEIDST, CONDST
163	X-CG miscellaneous weight, in.	WEIDST, CONDST
164	X-CG guns, in.	WEIDST, CONDST
165	X-CG fuselage pylons, in.	WEIDST, CONDST
166	X-CG fuselage external tanks, in.	WEIDST, CONDST
167	Not used	
.		
180	Not used	
Locations 181 through 221 contain wing and content weight data		
181	Wing weight, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
182	Main landing gear weight, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
183	Surface controls weight, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
184	Fuel system weight, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
185	Instruments weight, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
186	Trapped fuel weight, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
187	Wing pylons, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
188	Wing external tanks, lb	WEIDST, PRTOWE, WNGDST, DCCNTL
189	Not used	
.		
200	Not used	

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
201	X-CG wing, in.	WEIDST, WNGDST
202	X-CG main landing gear, in.	WEIDST, WNGDST, DCCNTL
203	X-CG surface controls, in.	WEIDST, WNGDST
204	X-CG fuel system, in.	WEIDST, WNGDST
205	X-CG instruments, in.	WEIDST, WNGDST
206	X-CG trapped fuel, in.	WEIDST, WNGDST
207	X-CG wing pylons, in.	WEIDST, WNGDST
208	X-CG wing external tanks, in.	WEIDST, WNGDST
209	Not used	
.		
220	Not used	
Locations 221 through 240 contain horizontal tail and content weight data		
221	Horizontal tail weight, lb	WEIDST, PRTOWE, AVDATA, DCCNTL, DMAXLD
222	Surface controls weight, lb	WEIDST, PRTOWE, AVDATA, DCCNTL, DMAXLD
223	Not used	
.		
230	Not used	
231	X-CG horizontal tail, in.	WEIDST, AVDATA, DMAXLD
232	X-CG Surface controls	WEIDST, DMAXLD
233	Not used	
.		
240	Not used	
Locations 241 through 260 contain vertical tail and content weight data		
241	Vertical tail weight, lb	WEIDST, PRTOWE, AVDATA, DCCNTL, DMAXLD
242	Surface controls weight, lb	WEIDST, PRTOWE, AVDATA, DCCNTL, DMAXLD
243	Not used	
.		
250	Not used	
251	X-CG vertical tail, in.	WEIDST, AVDATA, DMAXLD
252	X-CG surface controls, in.	WEIDST, DMAXLD

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
253	Not used	
.		
260	Not used	
Locations 261 through 300 contain weight items associated with inboard engine package		
261	Engine section and nacelle weight, lb	QUIKIE, PRTOWE, CONDST, AVDATA
262	Engine weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
263	Auxiliary gearboxes and drives weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
264	Air induction system structure weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
265	Air induction system actuators and controls weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
266	Exhaust system weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
267	Cooling and drains weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
268	Lubrication system weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
269	Starting system weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
270	Auxiliary power unit weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
271	Instruments weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
272	Hydraulics weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
273	Electrical weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
274	Air conditioning and anti-icing weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
275	Oil weight, lb	WEIDST, PRTOWE, CONDST, AVDATA
276	Not used	
.		
280	Not used	

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
281	X-CG engine section and nacelles, in.	QUIKIE, CONDST, AVDATA
282	X-CG engine, in.	WEIDST, CONDST, AVDATA
283	X-CG auxiliary gearboxes and drives, in.	WEIDST, CONDST, AVDATA
284	X-CG air induction system structure, in.	WEIDST, CONDST, AVDATA
285	X-CG air induction system actuators and controls, in.	WEIDST, CONDST, AVDATA
286	X-CG exhaust system, in.	WEIDST, CONDST, AVDATA
287	X-CG cooling and drains, in.	WEIDST, CONDST, AVDATA
288	X-CG lubrication system, in.	WEIDST, CONDST, AVDATA
289	X-CG starting system, in.	WEIDST, CONDST, AVDATA
290	X-CG auxiliary power unit, in.	WEIDST, CONDST, AVDATA
291	X-CG instruments, in.	WEIDST, CONDST, AVDATA
292	X-CG hydraulics, in.	WEIDST, CONDST, AVDATA
293	X-CG electrical, in.	WEIDST, CONDST, AVDATA
294	X-CG air conditioning and anti-icing, in.	WEIDST, CONDST, AVDATA
295	X-CG oil, in.	WEIDST, CONDST, AVDATA
296	Not used	
.		
300	Not used	
Locations 301 through 340 contain weight items associated with outboard engine package		
301	Engine section and nacelle weight, lb	QUIKIE, PRTOWE, AVDATA
302	Engine weight, lb	WEIDST, PRTOWE, AVDATA
303	Auxiliary gearboxes and drives weight, lb	WEIDST, PRTOWE, AVDATA
304	Air induction system structure weight, lb	WEIDST, PRTOWE, AVDATA
305	Air induction system actuators and controls, lb	WEIDST, PRTOWE, AVDATA
306	Exhaust system weight, lb	WEIDST, PRTOWE, AVDATA
307	Cooling and drains weight, lb	WEIDST, PRTOWE, AVDATA
308	Lubrication system weight, lb	WEIDST, PRTOWE, AVDATA
309	Starting system weight, lb	WEIDST, PRTOWE, AVDATA

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
310	Auxiliary power unit weight, lb	WEIDST, PRTOWE, AVDATA
311	Instruments weight, lb	WEIDST, PRTOWE, AVDATA
312	Hydraulics weight, lb	WEIDST, PRTOWE, AVDATA
313	Electrical weight, lb	WEIDST, PRTOWE, AVDATA
314	Air conditioning and anti-icing weight, lb	WEIDST, PRTOWE, AVDATA
315	Oil weight, lb	WEIDST, PRTOWE, AVDATA
316	Not used	
.		
320	Not used	
321	X-CG engine section and nacelle, in.	QUIKIE, AVDATA
322	X-CG engine, in.	WEIDST, AVDATA
323	X-CG auxiliary gearboxes and drives, in.	WEIDST, AVDATA
324	X-CG air induction system structure, in.	WEIDST, AVDATA
325	X-CG air induction system actuators and controls, in.	WEIDST, AVDATA
326	X-CG exhaust system, in.	WEIDST, AVDATA
327	X-CG cooling and drains, in.	WEIDST, AVDATA
328	X-CG lubrication system, in.	WEIDST, AVDATA
329	X-CG starting system, in.	WEIDST, AVDATA
330	X-CG auxiliary power unit, in.	WEIDST, AVDATA
331	X-CG instruments, in.	WEIDST, AVDATA
332	X-CG hydraulics, in.	WEIDST, AVDATA
333	X-CG electrical, in.	WEIDST, AVDATA
334	X-CG air conditioning and anti-icing, in.	WEIDST, AVDATA
335	X-CG oil, in.	WEIDST, AVDATA
336	Not used	
.		
340	Not used	
341	WFUS(1), fuselage weight in shell segment 1, lb	FUSDST, AVDATA, AVDINR
.		
.	To	
360	WFUS(2), fuselage weight in shell segment 20, lb	FUSDST, AVDATA, AVDINR

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
361	Fixed-fuselage contents in shell segment 1, lb	CONDST, FTOTAL
.	To	
380	Fixed-fuselage contents in shell segment 20, lb	CONDST, FTOTAL
381	YW(1), wing weight distribution cut 1, in.	WNGDST
.	To	
393	YW(13), wing weight distribution cut 13, in.	WNGDST
394	YEA1, Y-station of wing elastic axis at wing cut 2 for fatigue evaluation (fixed or aft), in.	WHVGEO, DFATMG
395	XEA1, X-station of wing elastic axis at wing cut 2 for fatigue evaluation (fixed or aft), in.	WHVGEO, DFATMG
396	YEA2, Y-station of wing elastic axis at wing cut 2 for fatigue evaluation (fixed or forward), in.	WHVGEO, DFATMG
397	XEA2, X-station of wing elastic axis at wing cut 2 for fatigue evaluation (fixed or forward), in.	WHVGEO, DFATMG
398	Not used	
.		
400	Not used	
Locations 401 through 760, and 781 through 840 contain wing and fuselage distributed weight arrays which are referenced by specific variable names. Locations 761 through 780 are not used.		
841	Fuselage payload at MDW, lb	QUIKIE
842	Wing payload at MDW, lb	QUIKIE
843	Ammunition at MDW, lb	QUIKIE
844	Fuel, wing tank 1 at MDW, lb	QUIKIE
845	Fuel, wing tank 2 at MDW, lb	QUIKIE
846	Fuel, fuselage tank 1 at MDW, lb	QUIKIE
847	Fuel, fuselage tank 2 at MDW, lb	QUIKIE
848	Fuel, fuselage tank 3 at MDW, lb	QUIKIE
849	Fuel, fuselage tank 4 at MDW, lb	QUIKIE
850	Fuel, fuselage tank 5 at MDW, lb	QUIKIE

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
851	Fuselage payload at LDW, lb	QUIKIE
852	Wing payload at LDW, lb	QUIKIE
853	Ammunition at LDW, lb	QUIKIE
854	Fuel, wing tank 1 at LDW, lb	QUIKIE
855	Fuel, wing tank 2 at LDW, lb	QUIKIE
856	Fuel, fuselage tank 1 at LDW, lb	QUIKIE
857	Fuel, fuselage tank 2 at LDW, lb	QUIKIE
858	Fuel, fuselage tank 3 at LDW, lb	QUIKIE
859	Fuel, fuselage tank 4 at LDW, lb	QUIKIE
860	Fuel, fuselage tank 5 at LDW, lb	QUIKIE
861	Y-station wing synthesis cut 1 for wing in nominal sweep position, in.	WHVGEO, WNGDST, DCCNTL
.	To	
871	Y-station wing synthesis cut 11 for wing in nominal sweep position, in.	WHVGEO, WNGDST, DCCNTL
Locations 872 through 943 contain horizontal and vertical tail distributed weight arrays which are referenced by specific variable names		
944	Maximum design weight (MDW), lb	AVDATA, DBLCNT, DCCNTL, DMAXLD, DLNDGR
945	X-CG at MDW (fixed or aft), in.	AVDATA, DBLCNT
946	X-CG at MDW (fixed or fwd), in.	AVDATA, DBLCNT, DMAXLD, DLNDGR
947	Z-CG at MDW, in.	AVDATA, DLNDGR
948	Not used	
949	Pitch inertia at MDW (fixed or fwd), lb-in.^{2}	AVDATA
950	Yaw inertia at MDW (fixed or fwd), lb-in.^{2}	AVDATA
951	Basic flight design weight (BFDW), lb	AVDATA, DBLCNT, DCCNTL
952	X-CG at BFDW (fixed or aft), in.	AVDATA, DBLCNT
953	X-CG at BFDW (fixed or forward), in.	AVDATA, DBLCNT
954	Z-CG at BFDW	AVDATA
955	Not used	
956	Not used	
957	Pitch inertia at BFDW (fixed or aft), lb-in.^{2}	AVDATA, DBLCNT
958	Pitch inertia at BFDW (fixed or fwd), lb-in.^{2}	AVDATA, DBLCNT

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
959	Yaw inertia at BFDW (fixed or aft), lb-in.^{2}	AVDATA, DBLCNT
960	Yaw inertia at BFDW (fixed or fwd), lb-in.^{2}	AVDATA, DBLCNT
961	Landing design weight (LDW), lb	AVDATA, DBLCNT, DLNDGR
962	Not used	
963	X-CG at LDW (fixed or fwd), in.	AVDATA, DBLCNT, DLNDGR
964	Z-CG at LDW, in.	AVDATA
965	Not used	
966	Pitch inertia at LDW (fixed or fwd), lb-in.^{2}	AVDATA
967	Yaw inertia at LDW (fixed or fwd), lb-in.^{2}	AVDATA
968	Horizontal tail and contents weight, lb	AVDATA, DWHVQQ
969	X-CG horizontal tail and contents, in.	AVDATA, DWHVQQ
970	Y-CG horizontal tail and contents per side, in.	AVDATA, DWHVQQ
971	Not used	
972	Pitch inertia horizontal tail and contents, lb-in.^{2}	AVDATA, DWHVQQ
973	Yaw inertia horizontal tail and contents, lb-in.^{2}	AVDATA, DWHVQQ
974	Inboard nacelle package weight, lb	AVDATA, DCCNTL, DMAXLD, DFATMG
975	X-CG inboard nacelle package, in.	AVDATA, DCCNTL, DMAXLD, DFATMG
976	Not used	
977	Pitch inertia inboard nacelle package, lb-in.^{2}	AVDATA, DCCNTL
978	Yaw inertia inboard nacelle package, lb-in.^{2}	AVDATA, DCCNTL
979	Outboard nacelle package weight, lb	AVDATA, DCCNTL, DMAXLD, DFATMG
980	X-CG outboard nacelle package, in.	AVDATA, DCCNTL, DMAXLD, DFATMG
981	Not used	
982	Pitch inertia outboard nacelle package, lb-in.^{2}	AVDATA, DCCNTL

TABLE 38. DVWT WEIGHT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
983	Yaw inertia outboard nacelle package, $lb\text{-}in.^2$	AVDATA, DCCNTL
984	Not used	
•		
1000	Not used	

NOTE DVWT array starts at common location 2521.

TABLE 39. EQU ARRAY VARIABLES

Loc	Value	Description	Subroutine Reference
1	36.08924	Altitude, 1,000 ft	TEMPRE
2	2116.22	Ambient pressure at sea level, lb/ft^2	TEMPRE
3	0.00687559	Curve fit constant	TEMPRE
4	5.25591	Curve fit constant	TEMPRE
5	65.61688	Altitude, 1,000 ft	TEMPRE
6	20.80556	Curve fit constant	TEMPRE
7	472.68	Ambient pressure at 36,089 ft, lb/ft^2	TEMPRE
8	104.9869	Altitude, 1,000 ft	TEMPRE
9	114.345	Ambient pressure at 65,617 ft, lb/ft^2	TEMPRE
10	389.97	Curve fit constant	TEMPRE
11	-34.1634	Curve fit constant	TEMPRE
12	0.548641	Curve fit constant	TEMPRE
13	18.131	Ambient pressure at 104,987 ft, lb/ft^2	TEMPRE
14	1.53619	Curve fit constant	TEMPRE
15	411.57	Ambient temperature at 104,987 ft, ° R	TEMPRE
16	-12.2012	Curve fit constant	TEMPRE
17	154.19948	Altitude, 1,000 ft	TEMPRE
18	518.67	Ambient temperature at sea level, ° R	TEMPRE
19	3.56616	Curve fit constant	TEMPRE
20	389.97	Ambient temperature between 36,089 and 65,617 ft, ° R	TEMPRE
21	0.00000304	Curve fit constant	SPDALT
22	53.3	Gas constant, ft-lb/lb/° R	SPDALT
23	1.4	Ratio of specific heats	SPDALT
24	0.075	Constant-pressure recovery calculation	SPDALT
25	1.35	Constant-pressure recovery calculation	SPDALT
26	0.3	Constant airflow at engine, M	SPDALT
27	0.5	Constant airflow at engine, M	SPDALT
28	460.0	Conversion ° R to ° F	
29	12.53	Fixed spike weight estimate constant	QUIKIE
30	15.65	Translating spike weight estimate constant	QUIKIE
31	51.8	Translating and expanding spike weight estimate constant	QUIKIE
32	0.3	Constant-static pressure calculation	DSGNPR
33	0.05	Constant-static pressure calculation	DSGNPR
34	400.0	Constant-hammershock pressure calculation	DSGNPR
35	1.019056	Constant-hammershock pressure calculation	DSGNPR
36	0.0289156	Constant-hammershock pressure calculation	DSGNPR
37	1.350112	Constant-hammershock pressure calculation	DSGNPR

TABLE 39. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
38	0.664319	Constant-hammershock pressure calculation	DSGNPR
39	1.5	Constant-hammershock pressure calculation	DSGNPR
40	0.00602627	Constant-hammershock pressure calculation	DSGNPR
41	0.080725	Constant-hammershock pressure calculation	DSGNPR
42	3.16503	Constant-hammershock pressure calculation	DSGNPR
43	1.588524	Constant-hammershock pressure calculation	DSGNPR
44	1100.0	Constant-hammershock pressure calculation	DSGNPR
45	2.5	Constant-hammershock pressure calculation	DSGNPR
46	0.770476	Constant-hammershock pressure calculation	DSGNPR
47	0.1482515	Constant-hammershock pressure calculation	DSGNPR
48	4.371758	Constant-hammershock pressure calculation	DSGNPR
49	2.114969	Constant-hammershock pressure calculation	DSGNPR
50	900.0	Constant-hammershock pressure calculation	DSGNPR
51	1.538116	Constant-hammershock pressure calculation	DSGNPR
52	0.3029697	Constant-hammershock pressure calculation	DSGNPR
53	0.4872335	Constant-hammershock pressure calculation	DSGNPR
54	0.4653126	Constant-hammershock pressure calculation	DSGNPR
55	700.0	Constant-hammershock pressure calculation	DSGNPR
56 . 60		Not used Not used	
61	1.6	Constant-hammershock pressure calculation	DSGNPR
62	0.984	Constant-hammershock pressure calculation	DSGNPR
63	0.0074	Constant-hammershock pressure calculation	DSGNPR
64	0.0263	Constant-hammershock pressure calculation	DSGNPR
65	2000.0	Rule-of-thumb number of landings	SPDALT
66	0.975	Rule-of-thumb location of wing structural tip station, fraction of exposed span	WHVGEO
67	0.975	Rule-of-thumb location of horizontal tail structural tip station, fraction of exposed span	WHVGEO
68	0.975	Rule-of-thumb location of vertical tail structural tip station, fraction of exposed span	WHVGEO
69 . 70		Not used Not used	
71	2.0	Ramp weight estimate equation constant	QUIKIE
72	10.0	Ramp weight estimate equation constant	QUIKIE

TABLE 39. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
73	0.5	Ramp weight estimate equation exponent	QUIKIE
74	4.0	Duct lip unit weight estimate, lb/ft^2	QUIKIE
75	1.5	Duct weight estimate equation constant	QUIKIE
76	10.0	Duct weight estimate equation constant	QUIKIE
77	0.5	Duct weight estimate equation exponent	QUIKIE
78	1.0	Duct weight estimate equation index factor	QUIKIE
79	2.5	Nacelle unit weight estimate, lb/ft^2	QUIKIE
80	12.0	Pylon unit weight estimate, lb/ft^2	QUIKIE
81	0.015	Engine mount weight estimate factor, fraction of engine weight	QUIKIE
82	0.437	Wing weight equation gross weight exponent	QUIKIE
83	0.132	Wing weight equation dynamic pressure exponent	QUIKIE
84	0.758	Wing weight equation area exponent	QUIKIE
85	0.600	Wing weight equation aspect ratio exponent	QUIKIE
86	0.296	Wing weight equation thickness ratio exponent	QUIKIE
87	0.04	Wing weight equation taper ratio exponent	QUIKIE
88	1.05	Wing weight equation landing gear factor	QUIKIE
89	1.35	Wing weight equation pivot increment constant	QUIKIE
90	0.35	Wing weight equation pivot increment constant	QUIKIE
91	27.67	Wing weight equation constant	QUIKIE
92	1.0	Wing weight equation index factor	QUIKIE
93	0.430	Wing X-CG estimating factor	QUIKIE
94	0.414	Horizontal weight equation gross weight exponent	QUIKIE
95	0.168	Horizontal weight equation dynamic pressure exponent	QUIKIE
96	0.896	Horizontal weight equation area exponent	QUIKIE
97	0.043	Horizontal weight equation aspect ratio exponent	QUIKIE
98	0.121	Horizontal weight equation thickness ratio exponent	QUIKIE
99	0.025	Horizontal weight equation taper ratio exponent	QUIKIE
100	63.27	Horizontal weight equation constant	QUIKIE
101	1.0	Horizontal weight equation index factor	QUIKIE
102	0.43	Horizontal X-CG estimating factor	QUIKIE

TABLE 39. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
103	0.376	Vertical weight equation gross weight exponent	QUIKIE
104	0.122	Vertical weight equation dynamic pressure exponent	QUIKIE
105	0.873	Vertical weight equation area exponent	QUIKIE
106	0.357	Vertical weight equation aspect ratio exponent	QUIKIE
107	0.489	Vertical weight equation thickness ratio exponent	QUIKIE
108	0.039	Vertical weight equation taper ratio exponent	QUIKIE
109	13.72	Vertical weight equation constant	QUIKIE
110	1.0	Vertical weight equation index factor	QUIKIE
111	0.43	Vertical X-CG estimating factor	QUIKIE
112	0.4116	Landing gear weight equation load factor exponent	QUIKIE
113	0.7756	Landing gear weight equation weight exponent	QUIKIE
114	0.2136	Landing gear weight equation length exponent	QUIKIE
115	0.2192	Landing gear weight equation constant	QUIKIE
116		Not used	
117		Not used	
118	1.124	Fuselage weight equation area exponent	QUIKIE
119	0.172	Fuselage weight equation gross weight exponent	QUIKIE
120	0.047	Fuselage weight equation tail arm exponent	
121	0.065	Fuselage weight equation fineness ratio exponent	QUIKIE
122	0.241	Fuselage weight equation dynamic pressure exponent	QUIKIE
123	0.052	Fuselage weight equation constant	QUIKIE
124	1.0	Fuselage weight equation index factor	QUIKIE
125	0.55	Fuselage X-CG estimating factor	QUIKIE
126	0.48	Fuselage X-CG estimating factor	QUIKIE
127		Not used	
128	0.532	Surface control distribution factor, wing	WEIDST
129	0.128	Surface control distribution factor, horizontal	WEIDST

TABLE 39. EQU ARRAY VARIABLES (CONCL)

Loc	Value	Description	Subroutine Reference
130	0.124	Surface control distribution factor, vertical	WEIDST
131	0.038	Surface control distribution factor, cockpit	WEIDST
132	0.178	Surface control distribution factor, fuselage	WEIDST
133	0.724	Surface control distribution factor, variable-sweep wing	WEIDST
134	0.274	Surface control distribution factor, spindle-mounted horizontal	WEIDST
135	0.290	Surface control distribution factor, spindle-mounted vertical	WEIDST
136	0.90	Armament distribution factor for gun package	CONDST
137	0.10	Instruments distribution factor for fuel tanks	WEIDST
138	0.70	Instruments distribution factor for cockpit	CONDST
139	0.33	Hydraulics distribution factor for engine package	WEIDST
140	0.25	Electrical distribution factor for engine package	WEIDST
141	0.20	Air conditioning distribution factor for engine package	WEIDST
142	0.50	Electronics distribution factor for second compartment	CONDST
143	500.0	Gun-related armament item distribution factor	CONDST
144	1.05	Nose geometry shape change factor for short shell segments	NOSGEO
145	0.98	Tolerance limit on shape correction factor for error message	FUSGEO, DUCGEO, NACGEO
146	1.02	Tolerance limit on shape correction factor for error message	FUSGEO, DUCGEO, NACGEO
147		Not used	
•			
200		Not used	

NOTE EQU array starts at common location 81.

TABLE 40. GDB FUSELAGE INPUT DATA ARRAY VARIABLES

Loc	Var Name	Description	Subroutine Reference
1	KC	Perimeter or perimeter correction factor 1 = perimeter input 2 = perimeter correction factor input	DATAIN
2	NC	Number of shell synthesis cuts	DATAIN
3		Not used	
•		To	
5		Not used	
6	XI(1)	X-station of shell geometry cut 1, in.	FUSGEO, WHVGEO, NOSGEO, QUIKIE, FUSDST
•	•	To	
15	XI(10)	X-station of shell geometry cut 10, in.	FUSGEO, WHVGEO, NOSGEO, QUIKIE, FUSDST
16	ZI(1)	Z-station of fuselage half-depth at shell geometry cut 1, in.	FUSGEO, WHVGEO
•	•	To	
25	ZI(10)	Z-station of fuselage half-depth at shell geometry cut 10, in.	FUSGEO, WHVGEO
26	DI(1)	Fuselage depth at shell geometry cut 1, in.	FUSGEO
•	•	To	
35	DI(10)	Fuselage depth at shell geometry cut 10, in.	FUSGEO
36	WI(1)	Fuselage width at shell geometry cut 1, in.	FUSGEO
•	•	To	
45	WI(10)	Fuselage width at shell geometry cut 10, in.	FUSGEO
46	PI(1)	Fuselage perimeter or perimeter correction factor at shell geometry cut 1, in.	FUSGEO
•	•		
55	PI(10)	Fuselage perimeter or perimeter correction factor at shell geometry cut 10, in.	FUSGEO
56	XO(1)	X-station of shell synthesis cut 1, in.	FUSGEO, NOSGEO, FUSDST, DSTTRI, DSTTRP
•			
74	XO(19)	X-station of shell synthesis cut 19, in.	FUSGEO, NOSGEO, FUSDST, DSTTRI, DSTTRP

TABLE 40. GDB FUSELAGE INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Var Name	Description	Subroutine Reference
75	X0(20)	Tail station, XI(10), when there are 19 synthesis cuts, in.	FUSGEO, NOSGEO, FUSDST, DSTTRI, DSTTRP
76		Not used	
.			
80		Not used	

NOTE GDB array starts at common location 1081.

TABLE 41. GDD ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Maximum design weight (MDW), lb	QUIKIE
2	Not used	
3	Basic flight design weight (BFDW), lb	QUIKIE
4	X-CG at basic flight design weight with wing in nominal (input) position, in.	
5	Landing design weight (LDW), lb	QUIKIE
6	Not used	
7	Air vehicle service life, hr	DFATMG
8	Number of landings	SPDALT, DFATMG
9	Takeoff weight for fatigue evaluation, lb	DFATMG
10	Landing weight for fatigue evaluation, lb	DFATMG
11	Maximum positive maneuver load factor, subsonic, at BFDW	QUIKIE, DBLCNT, DCCNTL, DMAXLD
12	Maximum positive maneuver load factor, supersonic, at BFDW	QUIKIE, DBLCNT, DCCNTL
13	Maximum negative maneuver load factor, at BFDW	DBLCNT, DCCNTL, DMAXLD
14	Maximum positive flap-down maneuver load factor at MDW	QUIKIE, DBLCNT, DCCNTL
15	Pitching acceleration at limit speed for BFDW, rad/sec^2	DBLCNT
16	Yawing acceleration at limit speed for BFDW, rad/sec^2	DBLCNT
17	Minimum speed, flaps up, at MDW, knots	DBLCNT
18	Minimum speed, flaps down, at LDW, knots	DBLCNT, DLNDGR
19	Design sink speed at MDW, ft/sec	DLNDGR
20	Design sink speed at LDW, ft/sec	QUIKIE, DLNDGR

TABLE 41. GDD ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
21	Main landing gear stroke, fully extended to fully compressed, in.	QUIKIE, DLNDGR
22	Nose landing gear stroke, fully extended to fully compressed, in.	DLNDGR
23	Main landing gear length with oleo extended, axle to trunnion centerline, in.	QUIKIE, DLNDGR
24	Nose landing gear length with oleo extended, axle to trunnion centerline, in.	QUIKIE, DLNDGR
25	Main landing gear center-of-gravity X-station in retracted position, in.	QUIKIE
26	Main gear center-of-axle X-station in extended position, in.	QUIKIE, DMAXLD, DLNDGR
27	Nose gear center-of-axle X-station in extended position, in.	QUIKIE, DMAXLD, DLNDGR
28	Ground line Z-station at main gear, in.	DLNDGR
29	Main gear center-of-axle Y-station with gear extended, in.	DCCNTL, DMAXLD, DLNDGR
30	Not used	
NOTE	GDD array starts at common location 721.	

TABLE 42. GDH HORIZONTAL TAIL INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Horizontal tail planform area (refer to location 30), ft^2	WHVGEO
2	Aspect ratio (refer to location 30)	WHVGEO
3	Taper ratio (refer to location 30)	WHVGEO
4	Sweep of reference axis, deg	WHVGEO
5	Reference axis location, fraction of total chord	WHVGEO
6	Not used	
7	Buttock line of horizontal to fuselage tie, in.	WHVGEO
8	X-station of leading edge apex (refer to location 30), in.	WHVGEO
9	X-station of quarter chord at mean aerodynamic chord (refer to location 30), in.	WHVGEO
10	Dihedral angle, deg	DCCNTL
11	Z-station of horizontal tail reference plane, in.	WHVGEO, AVDATA, AVDAOC, AVDINR, DWHVQQ, DCCNTL
12	Thickness ratio at root	QUIKIE, DWHVQQ, DCCNTL
13	Ratio of thickness ratio at tip to thickness ratio at root	DCCNTL
14	Not used	
15	Not used	
16	Structural elastic axis location fraction of total chord	WHVGEO
17	Input synthesis cut format indicator 0 = synthesis cuts input as either Y-coordinates or fractions of exposed span 1 = synthesis cuts input as swept elastic axis stations	WHVGEO
18	Input cut indicator 0 = not input compute 1 = input in format designated by location 17	WHVGEO

TABLE 42. GDH HORIZONTAL TAIL INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
19	Synthesis cut stations from root (station 1) to tip (station 11) (refer to locations 17 and 18)	WHVGEO
.	To	
29	Synthesis cut station 11	WHVGEO
30	Input planform data type indicator 0 = gross planform data given 1 = exposed planform data given	WHVGEO
31	Not used	
.	.	
40	Not used	

NOTE GDH array starts at common location 1001.

TABLE 43. GDI ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Vehicle class 11.0 = fighters and attack 21.0 = bombers 31.0 = transports for wheeled vehicles heavier than 100K 32.0 = transports for wheeled vehicles lighter than 100K 33.0 = transports for bulk cargo heavier than 100K 34.0 = transports for bulk cargo lighter than 100K 35.0 = transports for personnel heavier than 100K 36.0 = transports for personnel lighter than 100K	SPDALT, CONDST
2	Variable-sweep wing indicator 0 = fixed wing + = variable sweep indicator	WHVGEO, WEIDST, WNGDST, DBLCNT, DCCNTL, DFATMG, DMAXLD, QUIKIE, DWHVQQ
3	Landing gear location indicator 0 = fuselage-mounted main gear + = wing-mounted main gear	WHVGEO, WEIDST, DMAXLD, QUIKIE
4	Horizontal tail-type indicator 0 = shear tie - slab tail 1.0 = shear and moment tie 2.0 = spindle mounted	WHVGEO, WEIDST
5	Vertical tail-type indicator 0 = shear tie-slab tail 1.0 = shear and moment tie 2.0 = spindle mounted	WEIDST
6	Auxiliary power unit location indicator 0 = nacelle mounted + = fuselage mounted	WEIDST

TABLE 43. GDI ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
7	Nacelle location indicator 0 = wing mounted + = fuselage mounted	CONDST, AVDINR, DCCNTL, DFATMG, DMAXLD
8	Horizontal tail location indicator 0 = fuselage mounted + = vertical tail mounted	WHVGEO
9	Wing carry-thru structure indicator 0 = shear tie + = shear and moment tie	
10	Not used	
.		
15	Not used	
16	Wing lift carry-over reduction factor 0.0 = no reduction X.XX = effective lift carry-over factor	DBLCNT
17	Horizontal tail lift carry-over reduction tactor 0.0 = no reduction X.XX = effective lift carry-over factor	DBLCNT
18	Vertical tail lift carry-over reduction factor 0.0 = no reduction X.XX = effective lift carry-over factor	DBLCNT
19	Speed-altitude point for flight load investigation; if zero, point 3 on input profile is used	DBLCNT
20	Speed-altitude point for flight load investigation; if zero, point 4 on input profile is used.	DBLCNT

NOTE GDI array starts at common location 701.

TABLE 44. GDV VERTICAL TAIL INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Vertical tail planform area, ft^2	WHVGEO, QUIKIE, DCCNTL
2	Aspect ratio	WHVGEO, QUIKIE, DCCNTL
3	Taper ratio	WHVGEO, QUIKIE, DCCNTL
4	Sweep of reference axis, deg	WHVGEO, DCCNTL
5	Reference axis location, fraction of total chord	WHVGEO, DCCNTL
6	Not used	
7	Buttock line of vertical tail root, in. 0 = single vertical tail (+) = dual vertical tails	WHVGEO, AVDAOC, AVDINR, DCCNTL
8	X-station of leading edge apex, in.	WHVGEO
9	X-station of quarter chord at mean aerodynamic chord, in.	WHVGEO
10	Dihedral angle, deg	DCCNTL
11	Z-station of vertical tail root	WHVGEO, DCCNTL
12	Thickness ratio at root	QUIKIE, DCCNTL
13	Ratio of thickness ratio at tip to thickness ratio at root	DCCNTL
14	Not used	
15	Not used	
16	Structural elastic axis location, fraction of total chord	WHVGEO, DCCNTL

TABLE 44. GDV VERTICAL TAIL INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
17	Input = synthesis cut format indicator 0 = synthesis cuts input as either Z-coordinates or fractions of exposed span 1 = synthesis cuts input as swept elastic axis stations	
18	Input cut indicator 0 = not input, compute 1 = input in format designated by location 17	WHVGEO
19	Synthesis cut stations from root (station 1) to tip (station 11), (refer to locations 17 and 18)	WHVGEO
.	To	
29	Synthesis cut station 11	WHVGEO
30	Vertical tail location indicator 0 = fuselage mounted 1 = wing mounted	WHVGEO, AVDINR
31	Not used	
.	To	
40	Not used	
NOTE	GDV array starts at common location 1041.	

TABLE 45. GDW WING INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Wing planform area, ft^2	WHVGEO, QUIKIE, DCCNTL
2	Aspect ratio	WHVGEO, QUIKIE, DCCNTL
3	Taper ratio	WHVGEO, QUIKIE, WNGDST, DCCNTL
4	Sweep of reference axis, deg	WHVGEO, WNGDST, DCCNTL
5	Reference axis location, fraction of total chord	WHVGEO, DCCNTL
6	Not used	
7	Buttock line of wing to fuselage tie, in.	WHVGEO, DCCNTL
8	X-station of leading edge apex, in.	WHVGEO
9	X-station of quarter chord at mean aerodynamic chord, in.	WHVGEO
10	Dihedral angle, deg	DCCNTL
11	Z-station of wing reference plane, in.	AVDATA, AVDAOC, AVDINR, DCCNTL
12	Thickness ratio at root	QUIKIE, WNGDST, DCCNTL
13	Ratio of thickness ratio at tip to thickness ratio at root	WNGDST, DCCNTL
14	Not used	
15	Not used	
16	Structural elastic axis location, fraction of total chord	WHVGEO, DCCNTL

TABLE 45. GDW WING INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
17	Input synthesis cut format indicator 0 = synthesis cuts input as either Y-coordinates or fractions of exposed span 1 = synthesis cuts input as swept elastic axis stations	WHVGEO
18	Input cut indicator 0 = not input, compute 1 = input in format designated by location 17	WHVGEO
19	Synthesis cut stations from root (station 1) to tip (station 11) (refer to locations 17 and 18)	WHVGEO
•	To	
29	Synthesis cut station 11	WHVGEO
30	Density of fuel in wing, lb/in.^{3}	DCCNTL
31	Y-station of wing pivot axis, in.	WHVGEO, QUIKIE, WNGDST, DCCNTL
32	X-station of wing pivot axis, in.	WHVGEO, QUIKIE, WNGDST, DCCNTL
33	Aft sweep position angle of reference axis, deg	WHVGEO, QUIKIE, WNGDST, DCCNTL
34	Forward sweep position angle of reference axis, deg	WHVGEO, QUIKIE, WNGDST, DCCNTL
35	Not used	
36	Not used	
37	Y-station of flap inboard end, in.	DBLCNT
38	Y-station of flap outboard end, in.	DBLCNT
39	Flap chord to total chord ratio	DBLCNT
40	Maximum flap deflection, deg	DBLCNT
41	Not used	
•		
50	Not used	

NOTE GDW array starts at common location 951.

TABLE 46. GDWT ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Wing weight, lb	QUIKIE
2	Horizontal tail weight, lb	QUIKIE
3	Vertical tail weight, lb	QUIKIE
4	Fuselage weight, lb	QUIKIE
5	Main landing gear weight, lb	QUIKIE
6	Nose landing gear weight, lb	QUIKIE
7	Surface controls weight, lb	QUIKIE
8	Engine section and nacelle weight, lb	QUIKIE
9	Other structure weight, lb	QUIKIE
10	Engine weight, lb	QUIKIE
11	Auxiliary gearboxes and drives weight, lb	QUIKIE
12	Air induction system structure weight, lb	QUIKIE
13	Air induction system actuators and controls weight, lb	QUIKIE
14	Exhaust system weight, lb	QUIKIE
15	Cooling and drain weight, lb	QUIKIE
16	Lubrication system weight, lb	QUIKIE
17	Fuel system weight, lb	QUIKIE
18	Engine controls weight, lb	QUIKIE
19	Starting system weight, lb	QUIKIE
20	Auxiliary power unit weight, lb	QUIKIE
21	Instruments weight, lb	QUIKIE

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
22	Hydraulic weight, lb	QUIKIE
23	Electrical weight, lb	QUIKIE
24	Electronics weight, lb	QUIKIE
25	Armament weight, lb	QUIKIE
26	Furnishings weight, lb	QUIKIE
27	Air-conditioning and anti-icing weight, lb	QUIKIE
28	Photographic weight, lb	QUIKIE
29	Auxiliary gear weight, lb	QUIKIE
30	Other item weight, lb	QUIKIE
31	Crew weight, lb	QUIKIE
32	Trapped fuel weight, lb	QUIKIE
33	Oil weight, lb	QUIKIE
34	Liquid nitrogen weight, lb	QUIKIE
35	Miscellaneous weight, lb	QUIKIE
36	Guns weight, lb	QUIKIE
37	Wing pylons weight, lb	QUIKIE, DCCNTL
38	Wing external tanks weight, lb	QUIKIE
39	Fuselage pylons weight, lb	QUIKIE
40	Fuselage external fuel tank weight, lb	QUIKIE
41	X-CG wing, in.	QUIKIE
42	X-CG horizontal tail, in.	QUIKIE

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
43	X-CG vertical tail, in.	QUIKIE
44	X-CG fuselage, in.	QUIKIE
45	X-CG main landing gear, in.	QUIKIE
46	X-CG nose landing gear, in.	QUIKIE
47	X-CG surface controls, in.	QUIKIE
48	X-CG engine section and nacelles, in.	QUIKIE
49	X-CG other structure, in.	QUIKIE
50	X-CG engine, in.	QUIKIE
51	X-CG auxiliary gearboxes and drives, in.	QUIKIE
52	X-CG air induction system structure, in.	QUIKIE
53	X-CG air induction system actuators and controls, in.	QUIKIE
54	X-CG exhaust system, in.	QUIKIE
55	X-CG cooling and drains, in.	QUIKIE
56	X-CG lubrication system, in.	QUIKIE
57	X-CG fuel system, in.	QUIKIE
58	X-CG engine controls, in.	QUIKIE
59	X-CG starting system, in.	QUIKIE
60	X-CG auxiliary power unit, in.	QUIKIE
61	X-CG instruments, in.	QUIKIE
62	X-CG hydraulics, in.	QUIKIE
63	X-CG electrical, in.	QUIKIE

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
64	X-CG electronics, in.	QUIKIE
65	X-CG armament, in.	QUIKIE
66	X-CG furnishings, in.	QUIKIE
67	X-CG air conditioning and anti-icing, in.	QUIKIE
68	X-CG photographic, in.	QUIKIE
69	X-CG auxiliary gear, in.	QUIKIE
70	X-CG other items, in.	QUIKIE
71	X-CG crew, in.	QUIKIE
72	X-CG trapped fuel, in.	QUIKIE
73	X-CG oil, in.	QUIKIE
74	X-CG liquid nitrogen, in.	QUIKIE
75	X-CG miscellaneous, in.	QUIKIE
76	X-CG guns, in.	QUIKIE
77	X-CG wing pylons, in.	QUIKIE, DCCNTL
78	X-CG wing external tanks, in.	QUIKIE
79	X-CG fuselage pylons, in.	QUIKIE
80	X-CG fuselage external tanks, in.	QUIKIE
81	Fuselage payload weight, lb	QUIKIE, PRTOWE, FTOTAL
82	Wing payload weight, lb	QUIKIE, PRTOWE, WNGDST, DCCNTL
83	Ammunition weight, lb	QUIKIE, PRTOWE, FTOTAL

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
84	Fuel, wing tank 1, lb	QUIKIE, WEIDST, PRTOWE, WNGDST, DCCNTL
85	Fuel, wing tank 2, lb	QUIKIE, WEIDST, PRTOWE, WNGDST, DCCNTL
86	Fuel, fuselage fuel tank 1, lb	QUIKIE, WEIDST, PRTOWE, FTOTAL, DCCNTL
87	Fuel, fuselage fuel tank 2, lb	QUIKIE, WEIDST, PRTOWE, FTOTAL DCCNTL
88	Fuel, fuselage fuel tank 3, lb	QUIKIE, WEIDST, PRTOWE, FTOTAL, DCCNTL
89	Fuel, fuselage fuel tank 4, lb	QUIKIE, WEIDST, PRTOWE, FTOTAL, DCCNTL
90	Fuel, fuselage fuel tank 5, lb	QUIKIE, WEIDST, PRTOWE, FTOTAL, DCCNTL
91	X-CG fuselage payload, in.	QUIKIE, PRTOWE, FTOTAL
92	X-CG wing payload, in.	QUIKIE, PRTOWE, WNGDST, DCCNTL
93	X-CG ammunition, in.	QUIKIE, PRTOWE, FTOTAL
94	X-CG fuel, wing tank 1, in.	QUIKIE, WEIDST, PRTOWE, WNGDST, DCCNTL

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
95	X-CG fuel, wing tank 2, in.	QUIKIE, WEIDST, PRTOWE, WNGDST, DCCNTL
96	X-CG fuel, fuselage tank 1, in.	QUIKIE, PRTOWE, FTOTAL
97	X-CG fuel, fuselage tank 2, in.	QUIKIE, PRTOWE, FTOTAL
98	X-CG fuel, fuselage tank 3, in.	QUIKIE, PRTOWE, FTOTAL
99	X-CG fuel, fuselage tank 4, in.	QUIKIE, PRTOWE, FTOTAL
100	X-CG fuel, fuselage tank 5, in.	QUIKIE, PRTOWE, FTOTAL
101	X-station fuselage payload forward end, in.	FTOTAL
102	X-station fuselage payload aft end, in.	CONDST, FTOTAL
103	Y-station wing inboard store location, in.	WNGDST, DCCNTL
104	Y-station wing outboard store location, in.	WNGDST, DCCNTL
105	Y-station wing fuel tank 1 inboard rib, in.	WNGDST, DCCNTL
106	Y-station wing fuel tank 1 outboard rib, in.	WNGDST, DCCNTL
107	Y-station wing fuel tank 2 inboard rib, in.	WNGDST, DCCNTL
108	Y-station wing fuel tank 2 outboard rib, in.	WNGDST, DCCNTL
109	X-station fuselage fuel tank 1 forward end, in.	CONDST, FTOTAL
110	X-station fuselage fuel tank 1 aft end, in.	CONDST, FTOTAL
111	X-station fuselage fuel tank 2 forward end, in.	CONDST, FTOTAL
112	X-station fuselage fuel tank 2 aft end, in.	CONDST, FTOTAL

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
113	X-station fuselage fuel tank 3 forward end, in.	CONDST, FTOTAL
114	X-station fuselage fuel tank 3 aft end, in.	CONDST, FTOTAL
115	X-station fuselage fuel tank 4 forward end, in.	CONDST, FTOTAL
116	X-station fuselage fuel tank 4 aft end, in.	CONDST, FTOTAL
117	X-station fuselage fuel tank 5 forward end, in.	CONDST, FTOTAL
118	X-station fuselage fuel tank 5 aft end, in.	CONDST, FTOTAL
119	Not used	
120	Not used	
121	Fraction of fuselage payload aboard at MDW	QUIKIE, FTOTAL
122	Fraction of wing payload aboard at MDW	QUIKIE, WNGDST
123	Fraction of ammunition aboard at MDW	QUIKIE, FTOTAL
124	Fraction of fuel in wing tank 1 at MDW	QUIKIE, WNGDST, DCCNTL
125	Fraction of fuel in wing tank 2 at MDW	QUIKIE, WNGDST, DCCNTL
126	Fraction of fuel in fuselage tank 1 at MDW	QUIKIE, FTOTAL, DCCNTL
127	Fraction of fuel in fuselage tank 2 at MDW	QUIKIE, FTOTAL, DCCNTL
128	Fraction of fuel in fuselage tank 3 at MDW	QUIKIE, FTOTAL, DCCNTL
129	Fraction of fuel in fuselage tank 4 at MDW	QUIKIE, FTOTAL, DCCNTL
130	Fraction of fuel in fuselage tank 5 at MDW	QUIKIE, FTOTAL, DCCNTL

TABLE 46. GDWT ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
131	Fraction of fuselage payload aboard at BFDW	QUIKIE, FTOTAL
132	Fraction of wing payload aboard at BFDW	QUIKIE, WNGDST
133	Fraction of ammunition aboard at BFDW	QUIKIE, FTOTAL
134	Fraction of fuel in wing tank 1 at BFDW	QUIKIE, WNGDST, DCCNTL
135	Fraction of fuel in wing tank 2 at BFDW	QUIKIE, WNGDST, DCCNTL
136	Fraction of fuel in fuselage tank 1 at BFDW	QUIKIE, FTOTAL, DCCNTL
137	Fraction of fuel in fuselage tank 2 at BFDW	QUIKIE, FTOTAL, DCCNTL
138	Fraction of fuel in fuselage tank 3 at BFDW	QUIKIE, FTOTAL, DCCNTL
139	Fraction of fuel in fuselage tank 4 at BFDW	QUIKIE, FTOTAL, DCCNTL
140	Fraction of fuel in fuselage tank 5 at BFDW	QUIKIE, FTOTAL, DCCNTL
141	Fraction of fuselage payload aboard at LDW	QUIKIE, FTOTAL
142	Fraction of wing payload aboard at LDW	QUIKIE, WNGDST
143	Fraction of ammunition aboard at LDW	QUIKIE, FTOTAL
144	Fraction of fuel in wing tank 1 at LDW	QUIKIE, WNGDST
145	Fraction of fuel in wing tank 2 at LDW	QUIKIE, WNGDST
146	Fraction of fuel in fuselage tank 1 at LDW	QUIKIE, FTOTAL
147	Fraction of fuel in fuselage tank 2 at LDW	QUIKIE, FTOTAL
148	Fraction of fuel in fuselage tank 3 at LDW	QUIKIE, FTOTAL

TABLE 46. GDWT ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
149	Fraction of fuel in fuselage tank 4 at LDW	QUIKIE, FTOTAL
150	Fraction of fuel in fuselage tank 5 at LDW	QUIKIE, FTOTAL
151	X-station, forward electronics compartment, in.	CONDST
152	X-station, intermediate electronics compartment, in.	CONDST
153	X-station, aft electronics compartment, in.	CONDST
154	Number of crewmembers	
155	Number of guns	
156	Not used	
•		
160	Not used	
NOTE	GDWT array starts at common location 791.	

TABLE 47. ND ARRAY VARIABLES

Loc	Var Name	Description	Subroutine Reference
1 • 100		Not used Not used	
101	I	Scratch counter	
102	J	Scratch counter	
103	K	Scratch counter	
104	L	Scratch counter	
105	M	Scratch counter	
106	N	Scratch counter	
107	II	Scratch counter	
108	JJ	Scratch counter	
109	KK	Scratch counter	
110	LL	Scratch counter	
111	ITP	Number of nacelles	DATAIN, OUIKIE, AVDATA
112	IVG	Inlet-type indicator 1 = fixed duct 2 = fixed spike 3 = two-dimensional horizontal ramps 4 = two-dimensional vertical ramps 5 = translating spike 6 = translating and expanding spike	DATAIN, DSGNPR, QUIKIE
113		Not used	
114	IGD	Duct leading-edge-type indicator 0 = compatible section 1 = vertical lip 2 = horizontal lip	DUCGEO, QUIKIE

TABLE 47. ND ARRAY VARIABLES (CONCL)

Loc	Var Name	Description	Subroutine Reference
115	NC	Number of fuselage, synthesis cuts	DATAIN, FUSGEO, NOSGEO, FUSDST, DSTNOR, DSTTRP, FTOTAL, AVDATA
116	KC	Fuselage perimeter code 1 = perimeter input 2 = perimeter correction factor input	DATAIN, FUSGEO
117	NCD	Number of duct cuts	DATAIN, DUCGEO, QUIKIE, CONDST
118	KCD	Duct perimeter code 1 = perimeter input 2 = perimeter correction factor input	DATAIN, DUCGEO,
119	NCN	Number of nacelle cuts	DATAIN, NACGEO, QUIKIE, AVDATA
120	KCN	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input	DATAIN, NACGEO
121	IGN	Nacelle leading edge type 0 = continuous section 1 = vertical lip 2 = horizontal lip	NACGEO, QUIKIE
122		Not used	
•			
200		Not used	

NOTE ND array starts at common location 4121.

TABLE 48. SPAL ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Horizontal tail and content weight per side, lb	DWHVQQ
2	Y-CG horizontal tail and content per side, in.	DWHVQQ
3	X-CG horizontal tail and content, in.	DWHVQQ
4	Z-CG horizontal tail and content, in.	DWHVQQ
5	Pitch inertia horizontal tail and contents, $lb\text{-}in.^2$	DWHVQQ
6	Roll inertia horizontal tail and contents, $lb\text{-}in.^2$	DWHVQQ
7	Yaw inertia horizontal tail and contents, $lb\text{-}in.^2$	DWHVQQ
8	Design mach number for T-tail, M	
9	Design dynamic pressure for T-tail, lb/ft^2	
10	Design shear modulus for T-tail flutter, $lb/in.^2$	
11	Correction factor for T-tail flutter	
12	Dihedral angle of horizontal tail, deg	DWHVQQ
13	Not used	
14	Not used	
15	Not used	
16	Flutter speed margin	DWHVQQ
17	Altitude 1 on M_L diagram (fixed or aft), ft	DWHVQQ
•	To	
25	Altitude 9 on M_L diagram (fixed or aft), ft	DWHVQQ
26	Mach number 1 on M_L diagram (fixed or aft), M	DWHVQQ
•	To	
34	Mach number 9 on M_L diagram (fixed or aft), M	DWHVQQ

TABLE 48. SPAL ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
35 • 37	Altitude 1 on M_L diagram (fwd), ft To Altitude 3 on M_L diagram (fwd), ft	DWHVQQ DWHVQQ
38 • 40	Mach number 1 on M_L diagram (fwd), M Mach 3 on M_L diagram (fwd), M	DWHVQQ DWHVQQ
41	Critical flutter altitude for wing forward, ft	
42	Mach number at critical flutter for wing fwd, M	
43	Wing temperature at critical flutter for wing fwd, ° F	
44	Dynamic pressure corrected for compressibility at critical flutter for wing fwd, lb/ft^2	
45	Shear modulus at critical flutter for wing fwd, $lb/in.^2$	
46	Wing temperature for flutter design with wing fixed or aft, ° F	
47	Horizontal tail temperature for flutter design ° F	
48	Vertical tail temperature for flutter design, ° F	
49	Vertical tail temperature for T-tail flutter design, ° F	
50	Not used	

NOTE SPAL array starts at common location 3721.

TABLE 49. TOT ARRAY VARIABLES

Loc	Var Name	Description	Subroutine Reference
1	STOT	Total fuselage surface area, $in.^2$	FUSGEO, QUIKIE, FUSDST
2	VOLT	Total fuselage volume, $in.^3$	FUSGEO
3		Not used	
•			
16		Not used	
17		Number of pressure cycles	SPDALT
18		Maximum cabin pressure differential, $lb/in.^2$	SPDALT SPDALT
19		Maximum fuselage depth, in.	FUSGEO, QUIKIE
20		Maximum fuselage width, in.	FUSGEO, QUIKIE
NOTE TOT array starts at common location 2191.			

TABLE 50. WD ARRAY VARIABLES

Loc	Description
1	Not used
2	Maximum design weight, lb
3	Basic flight design weight, lb
4	Maximum positive maneuver load factor, subsonic, at BFDW
5	Maximum negative maneuver load factor at BFDW
6	Maximum dynamic pressure, lb/ft^2
	Locations 7 through 110 contain wing-related data
7	Structural elastic axis location, fraction of total chord
8	Reference axis location, fraction of total chord
9	Ratio of wing weight per side to BFDW
10	Y-station of wing pivot axis, in.
11	X-station of wing pivot axis, in.
12	Forward sweep position angle of reference axis, deg
13	Aft sweep position of reference axis
14	X-station of leading edge apex, in.
15	Wing planform area, ft^2
16	Aspect ratio
17	Sweep of reference axis, deg
18	Taper ratio
19	Fuselage width at wing to fuselage tie, in.
20	Ratio of fuel system and trapped fuel to total wing fuel capacity
21	Surface controls weight per side, lb
22	Miscellaneous content weight per side, lb
23	Number of sweep positions for pivot evaluation (1.0)
24	Input cut format indicator (2.0)
25	Y-station wing synthesis cut 1 (root), in.
.	To
35	Y-station wing synthesis cut 11 (tip), in.
36	Wing fuel tank 1 capacity per side, lb
37	Fuel, wing tank 1 per side at BFDW, lb
38	X-CG fuel, wing tank 1, in.
39	Y-station wing fuel tank 1 inboard rib, in.
40	Y-station wing fuel tank 1 outboard rib, in.
41	Wing fuel tank 2 capacity per side, lb
42	Fuel, wing tank 2 per side at BFDW, lb
43	X-CG fuel, wing tank 2, in.
44	Y-station wing fuel tank 2 inboard rib, in.
45	Y-station wing fuel tank 2 outboard rib, in.
46	Inboard nacelle package weight per side, lb
47	Y-station inboard nacelle package, in.

TABLE 50. WD ARRAY VARIABLES (CONT)

Loc	Description
48	X-CG inboard nacelle package, in.
49	Vertical distance from inboard nacelle package to wing reference plane, in.
50	Inertia indicator for inboard nacelle package (1.0)
51	Pitch inertia inboard nacelle package per side, lb-in.^{2}
52	Not used (saved for roll inertia)
53	Yaw inertia inboard nacelle package per side, lb-in.^{2}
54	Outboard nacelle package weight per side, lb
55	Y-station outboard nacelle package, in.
56	X-CG outboard nacelle package, in.
57	Vertical distance from outboard nacelle package to wing reference plane, in.
58	Inertia indicator for outboard nacelle package (1.0)
59	Pitch inertia outboard nacelle package per side, lb-in.^{2}
60	Not used (saved for roll inertia)
61	Yaw inertia outboard nacelle package per side, lb-in.^{2}
62	Main landing gear weight per side, lb
63	Y-station main landing gear, in.
64	X-CG main landing gear, in.
65	Not used
.	
69	Not used
70	Wing inboard payload weight per side, lb
71	Y-station inboard payload, in.
72	X-CG inboard payload, in.
73	Not used
.	
77	Not used
78	Wing outboard payload weight per side, lb
79	Y-station outboard payload, in.
80	X-CG outboard payload, in.
81	Not used
.	
85	Not used
86	Wing inboard pylons weight per side, lb
87	Y station inboard pylons, in.
88	X-CG inboard pylons, in.
89	Not used
.	
93	Not used
94	Wing outboard pylons weight per side, lb
95	Y-station outboard pylons, in.

TABLE 50. WD ARRAY VARIABLES (CONT)

Loc	Description
96	X-CG outboard pylons, in.
97	Not used
.	
101	Not used
102	Wing fuel density, lb/in.^{3}
103	Fuel weight at MDW per vehicle, lb
104	Fuel expended from MDW to BFDW, lb
105	Payload and ammunition expended from MDW to BFDW, lb
106	Maximum positive maneuver load factor
107	Not used
.	
110	Not used
	Locations 111 through 133 contain horizontal-tail-related data
111	Structural elastic axis location, fraction of total chord
112	Reference axis location, fraction of total chord
113	Ratio of horizontal tail weight per side to BFDW
114	X-station of leading edge apex, in.
115	Horizontal tail planform area, ft^2
116	Aspect ratio
117	Sweep of reference axis, deg
118	Taper ratio
119	Fuselage width at horizontal tail to fuselage tie, in.
120	Surface controls weight per side, lb
121	Not used (saved for miscellaneous contents)
122	Input cut format indicator (2.0)
123	Y-station horizontal tail synthesis cut 1 (root), in.
.	
133	Y-station horizontal tail synthesis cut 11 (tip), in.
	Locations 134 through 156 contain vertical-tail-related data
134	Structural elastic axis location, fraction of total chord
135	Reference axis location, fraction of total chord
136	Ratio of vertical tail weight per side to BFDW
137	X-station of leading edge apex
138	Vertical tail planform area per panel times two, ft^2
139	Aspect ratio times two
140	Sweep of reference axis, deg
141	Taper ratio
142	Fuselage width at vertical tail interface (0.0)
143	Surface controls weight per side, lb

TABLE 50. WD ARRAY VARIABLES (CONCL)

Loc	Description
144	Not used (saved for miscellaneous contents)
145	Input cut format indicator (2.0)
146	Z-distance from structural root to vertical tail synthesis cut 1 (root), in.
.	
156	Z-distance from structural root to vertical tail synthesis cut 11 (tip), in.
157	Vertical-tail-type indicator 0.0 = conventional tail 1.0 = T-tail, horizontal mounted on vertical tail tip
158	Number of vertical tail panels
159	Wing dihedral angle, deg
160	Z-station of wing reference plane, in.
161	Wing thickness ratio at root
162	Ratio of wing thickness ratio at tip to thickness ratio at root
163	Horizontal tail dihedral angle, deg
164	Z-station of horizontal tail reference plane, in.
165	Horizontal tail thickness ratio at root
166	Ratio of horizontal tail thickness ratio at tip to thickness ratio at root
167	Vertical tail dihedral angle, deg
168	Z-station of vertical tail structural root, in.
169	Vertical tail thickness ratio at root
170	Ratio of vertical tail thickness ratio at tip to thickness ratio at root
171	Not used
.	
200	Not used

NOTE WD array starts at common location 3721.

TABLE 51. WLD ARRAY VARIABLES

Loc	Variable Name	Description
1	BDGW	Basic flight design weight (BFDW), lb
2	POSNZ	Maximum positive maneuver load factor
3	XNEGNZ	Maximum negative maneuver load factor
4 . . .	V2G(1) . . .	Wing net shear at 2 g taxi at wing weight analysis station 1 (wing fixed or forward) Outboard to
14	V2G(11)	Wing net shear at 2 g taxi at wing weight analysis station 11 (wing fixed or forward)
15 . . .	BM2G(1) . . .	Wing net bending moment at 2 g taxi at wing weight analysis station 1 (wing fixed or forward) Outboard to
25	BM2G(11)	Wing net bending moment at 2 g taxi at wing weight analysis station 11 (wing fixed or forward)
26 . . .	T2G(1) . . .	Wing and content net torque at 2 g taxi at wing weight analysis station 1 (wing fixed or forward) Outboard to
36	T2G(11)	Wing net torque at 2 g taxi at wing weight analysis station 11 (wing fixed or forward)
37 . . .	VW1(1) . . .	Wing only 1 g inertia shear at wing weight analysis station 1 (wing fixed or aft) Outboard to
47	VW1(11)	Wing only 1 g inertia shear at wing weight analysis station 11 (wing fixed or aft)
48 . . .	BMW1(1) . . .	Wing only 1 g inertia bending moment at wing weight analysis station 1 (wing fixed or aft) Outboard to
58	BMW1(11)	Wing only 1 g inertia bending moment at wing weight analysis station 11 (wing fixed or aft)

TABLE 51. WLD ARRAY VARIABLES (CONT)

Loc	Variable Name	Description
59 . . .	TW1(1) . . .	Wing only 1 g inertia torque at wing weight analysis station 1 (wing fixed or aft) Outboard to
69	TW1(11)	Wing only 1 g inertia torque at wing weight analysis station 11 (wing fixed or aft)
70 . . .	VW2(1) . . .	Wing only 1 g inertia shear at wing weight analysis station 1 (wing fixed or forward) Outboard to
80	VW2(11)	Wing only 1 g inertia shear at wing weight analysis station 11 (wing fixed or forward)
81 . . .	BMW2(1) . . .	Wing only 1 g inertia bending moment at wing weight analysis station 1 (w-ng fixed or forward) Outboard to
91	BMW2(11)	Wing only 1 g inertia bending moment at wing weight analysis station 11 (wing fixed or forward)
92 . . .	TW2(1) . . .	Wing only 1 g inertia torque at wing weight analysis station 1 (wing fixed or forward) Outboard to
102	TW2(11)	Wing only 1 g inertia torque at wing weight analysis station 11 (wing fixed or forward)
103 . . .	V21(1) . . .	Wing and content 1 g inertia shear at MDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
113	V21(11)	Wing and content 1 g inertia shear at MDW at wing weight analysis station 11 (wing fixed or forward)
114 . . .	BM21(1) . . .	Wing and content 1 g inertia bending moment at MDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
124	BM21(11)	Wing and content 1 g inertia bending moment at MDW at wing weight analysis station 11 (wing fixed or forward)

TABLE 51. WLD ARRAY VARIABLES (CONT)

Loc	Variable Name	Description
125	T21(1)	Wing and content 1 g inertia torque at MDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
.	.	
.	.	
.	.	
135	T21(11)	Wing and content 1 g inertia torque at MDW at wing weight analysis station 11 (wing fixed or forward)
136	V12(1)	Wing and content 1 g inertia shear at BFDWat wing weight analysis station 1 (wing fixed or aft) Outboard to
.	.	
.	.	
.	.	
146	V12(11)	Wing and content 1 g inertia shear at BFDW at wing weight analysis station 11 (wing fixed or aft)
147	BM12(1)	Wing and content 1 g inertia bending moment at BFDW at wing weight analysis station 1 (wing fixed or aft) Outboard to
.	.	
.	.	
.	.	
157	BM12(11)	Wing and content 1 g inertia bending moment at BFDW at wing weight analysis station 11 (wing fixed or aft)
158	T12(1)	Wing and content 1 g inertia torque at BFDWat wing weight analysis station 1 (wing fixed or aft) Outboard to
.	.	
.	.	
.	.	
168	T12(11)	Wing and content 1 g inertia torque at BFDW at wing weight analysis station 11 (wing fixed or aft)
169	V22(1)	Wing and content 1 g inertia shear at BFDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
.	.	
.	.	
.	.	
179	V22(11)	Wing and content 1 g inertia shear at BFDW at wing weight analysis station 11 (wing fixed or forward)
180	BM22(1)	Wing and content 1 g inertia bending moment at BFDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
.	.	
.	.	
.	.	
190	BM22(11)	Wing and content 1 g inertia bending moment at BFDW at wing weight analysis station 1 (wing fixed or forward)

TABLE 51. WLD ARRAY VARIABLES (CONT)

Loc	Variable Name	Description
191 . . .	T22(1) . . .	Wing and content 1 g inertia torque at BFDWat wing weight analysis station 1 (wing fixed or forward) Outboard to
201	T22(11)	Wing and content 1 g inertia torque at BFDW at wing weight analysis station 11 (wing fixed or forward)
202 . . .	V23(1) . . .	Wing and content 1 g inertia shear at LDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
212	V23(11)	Wing and content 1 g inertia shear at LDW at wing weight analsyis station 11 (wing fixed or forward)
213 . . .	BM23(1) . . .	Wing and content 1 g inertia bending moment at LDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
223	BM23(11)	Wing and content 1 g inertia bending moment at LDW at wing weight analysis station 11 (wing fixed or forward)
224 . . .	T23(1) . . .	Wing and content 1 g inertia torque at LDW at wing weight analysis station 1 (wing fixed or forward) Outboard to
234	T23(11)	Wing and content 1 g inertia torque at LDW at wing weight analysis station 11 (wing fixed or forward)
235 . . .	VH(1) . . .	Horizontal tail and content 1 g inertia shear at weight analysis station 1 Outboard to
245	VH(11)	Horizontal tail and content 1 g inertia shear at weight analysis station 11
246 . . .	BMH(1) . . .	Horizontal tail and content 1 g inertia bending moment at weight analysis station 1 Outboard to
256	BMH(11)	Horizontal tail and content 1 g inertia bending moment at weight analysis station 11

TABLE 51. WLD ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description
257	TH(1)	Horizontal tail and content 1 g inertia torque at weight analysis station 1
.	.	Outboard to
.	.	
.	.	
267	TH(11)	Horizontal tail and content 1 g inertia torque at weight analysis station 11
268	VV(1)	Vertical tail and content 1 g (lateral) inertia shear at weight analysis station 1
.	.	Outboard to
.	.	
.	.	
278	VV(11)	Vertical tail and content 1 g (lateral) inertia shear at weight analysis station 11
279	BMV(1)	Vertical tail and content 1 g (lateral) inertia bending moment at weight analysis station 1
.	.	Outboard to
.	.	
.	.	
289	BMV(11)	Vertical tail and content 1 g (lateral) inertia bending moment at weight analysis station 11
290	TV(1)	Vertical tail and content 1 g (lateral) inertia torque at weight analysis station 1
.	.	Outboard to
.	.	
.	.	
300	TV(11)	Vertical tail and content 1 g (lateral) inertia torque at weight analysis station 11

NOTE WLD array starts at common location 3821.

TABLE 52. IP ARRAY VARIABLES (IPRINT BLOCK)

Loc	Description	Figure Reference	Subroutine Reference
1 . 41	Locations 1 through 41 are print controls for other program modules		
42	Output print control of vehicle speed-altitude profile data for wing fixed or aft	28	SPDALT
43	Output print of inlet duct design pressure data	29	DSGNPR
44	Output print control of scratch region from QUIKIE (refer to Table 56)	31	QUIKIE
45	Output print control of component weight and inertia data transfered to fuselage module in record 34 (refer to Table 61)	35	AVDINR
46	Output print control of operational weight empty, first-level weight distribution, and useful load tables (refer to Tables 57, 58)	32,33	DATAIN (PRTOWE)
47	Output print control of vehicle design data stored for use by other program modules in records 18, 21, and 34 (refer to Tables 26, 50 and 51)	27,36,37, 38,39	DATAIN, DMAXLD, DCCNTL
48	Output print of scratch region from AVDATA, AVDAOC, AVDWNG, AVDINR group of routines (refer to Table 60)	34	AVDATA
49	Output print of complete common file after completion of data management module execution	26	DATAIN
50 . 80	Locations 50 through 80 are print controls for other program modules		

TABLE 53. XMISC ARRAY VARIABLES (MISC BLOCK)

Loc	Description	Subroutine Reference
1 . 11	Locations 1 through 11 contain controls and design data used by other program modules	
12	Aspect ratio of wing (fixed or aft)	WHVGEO
13	Quarter-chord sweep of wing (fixed or aft), deg	WHVGEO
14	Taper ratio of wing (fixed or aft)	WHVGEO
15	Wing structural material identification number	
16	Aspect ratio of horizontal tail	WHVGEO
17	Quarter-chord sweep of horizontal tail, deg	WHVGEO
18	Taper ratio of horizontal tail	WHVGEO
19	Horizontal tail structural material identification number	
20	Aspect ratio (twice actual) of vertical tail	WHVGEO
21	Quarter-chord sweep of vertical tail, deg	WHVGEO
22	Taper ratio of vertical tail	WHVGEO
23	Vertical tail structural material identification number	
24	Maximum design weight for landing gear design	DATAIN
25	Aspect ratio of wing (fwd)	WHVGEO
26	Quarter-chord sweep of wing (fwd), deg	WHVGEO
27	Taper ratio of wing (fwd)	WHVGEO
28 . 33	Locations 28 through 33 contain controls and design data used by other program modules	

TABLE 53. XMISC ARRAY VARIABLES (MISC BLOCK) (CONT)

Loc	Description	Subroutine Reference
34	Required vehicle life, hr	DFATMG
35 . 42	Locations 35 through 42 contain controls and design data used by other program modules	
43	Unswept bending moment at BFDW for wing fixed or aft at fatigue evaluation station 1, in.-lb	DFATMG
44	Swept bending moment at BFDW for wing fixed or aft at fatigue evaluation station 2, in.-lb	DFATMG
45	Unswept bending moment at MDW for wing fixed or forward at fatigue evaluation station 1, in.-lb	DFATMG
46	Unswept bending moment at BFDW for wing fixed or forward at fatigue evaluation station 1, in.-lb	DFATMG
47	Unswept bending moment at LDW for wing fixed or forward at fatigue evaluation station 1, in.-lb	DFATMG
48	Swept bending moment at MDW for wing fixed or forward at fatigue evaluation station 2, in.-lb	DFATMG
49	Swept bending moment at BFDW for wing fixed or forward at fatigue evaluation station 2, in.-lb	DFATMG
50	Swept bending moment at LDW for wing fixed or forward at fatigue evaluation station 2, in.-lb	DFATMG
51	Controls and design data used by other program modules	
52	Controls and design data used by other program modules	
53	Vertical tail type indicator 0 = conventional tail 1 = T-tail, horizontal tail mounted on vertical tail tip	DCCNTL

TABLE 53. XMISC ARRAY VARIABLES (MISC BLOCK) (CONCL)

Loc	Description	Subroutine Reference
54 . 84	Locations 54 through 84 contain controls and design data used by other program modules	
85 . 100	Locations 85 through 100 contain alphanumeric case data title (TITLE array)	SPDALT, DSGNPR

TABLE 54. MASS STORAGE FILE RECORDS

Record No.	Variable & Length	Write Routine	Read Routine	Description
11	D(1400)	Input data processing module	DATAIN	Input vehicle design data and constants (refer to first 1,400 cells of common in Table 24 for cross reference)
18	WLD(300)	DMAXLD		Surface 1 g inertia and wing net taxi loads data (refer to Table 51)
19	DV(2320)	DATAIN		Vehicle geometry and design data (refer to Table 34)
21	WD(200)	DCCNTL		Wing, horizontal tail, and vertical tail geometry and design data (refer to Table 50)
22	BC(195)	DATAIN		Vehicle design data (refer to Table 26)
25	D(116)	DLNDGR	DLNDGR	Landing gear design data (refer to subroutine DLNDGR discussion for description of variables)
34	FUSDWI(480)	AVDINR		Vehicle weight distribution and flight profile data (refer to Table 61)
38	SPAL(50)	DWHVQQ	DWHVQQ	Speed profile and surface flutter data (refer to Table 48)

SUBROUTINE DESCRIPTIONS

PROGRAM DATAIN

General Description

Deck name:	DATAIN
Entry name:	OVERLAY (5HALPHA, 2, 0)
Called by:	OLAY00
Subroutines called:	SPDALT, DSGNPR, FUSGEO, WHVGEO, DUCGEO, NACGEO, NOSGEO, QUIKIE, WEIDST, PRTOWE, WNGDST, FUSDST, CONDST, FTOTAL, AVDATA, DBLCNT, DWHVQQ, DCCNTL, DFATMG, DMAXLD, DLNDGR

This is the control routine for the data management module. This routine initializes the common region then reads the input design data from mass storage file record 11. Certain key indicators are defined from the input design data.

All routines in this module, with the exception of PRTOWE and DLNDGR, are always executed. Subroutine PRTOWE is called only if the operational weight empty and useful load data output print is requested. Subroutine DLNDGR is called when landing gear design data are required for execution of the landing gear module.

The sequence of calculations in this module is outlined below.

1. Evaluate speed profile (SPDALT, DSGNPR)

2. Calculate geometry data (FUSGEO, WHVGEO, DUCGEO, NACGEO, NOSGEO)

3. Calculate initial structural component weights and balance (QUIKIE)

4. Distribute vehicle masses (WEIDST, PRTOWE, WNGDST, FUSDST, CONDST, FTOTAL)

5. Calculate and organize data for use by other program modules (AVDATA, DBLCNT, DWHVQQ, DCCNTL, DFATMG, DMAXLD, DLNDGR)

After completion of all program calculations, the output region of common, DV array, is written on record 19 for use by the output module, The BC array is written on record 22 for use by the airloads module.

Arrays and Variables Used

BC	Vehicle design data for use by airloads module (refer to Table 26)
DATD(1)	Duct perimeter code 1 = perimeter input 2 = perimeter correction factor input
DATD(2)	Number of input duct cuts
DATN(1)	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input
DATN(2)	Number of input nacelle cuts
DATS(1)	Number of nacelles
DATS(3)	Inlet-type indicator 1 = fixed duct 2 = fixed spike 3 = two-dimensional horizontal ramps 4 = two-dimensional vertical ramps 5 = translating spike 6 = translating and expanding spike
DV	Calculated data array (refer to Table 34)
GDB(1)	Fuselage perimeter code 1 = perimeter input 2 = perimeter correction factor input
GDB(2)	Number of fuselage synthesis cuts

Arrays and Variables Calculated

ITP	(refer to DATS(1))
IVG	(refer to DATS(3))
KC	(refer to GDB(1))
KCD	(refer to DATD(1))
KCN	(refer to DATN(1))
NC	(refer to GDB(2))
NCD	(refer to DATD(2))
NCN	(refer to DATN(2))

Scratch Arrays and Variables

K	Scratch counter
N	Scratch counter

Labeled Common Arrays

IP(46)	Print/no-print indicator 0 = print operational weight empty and useful load data (refer to subroutine PRTOWE discussion) 1 = no print
IP(47)	Print/no-print indicator 0 = print BC array variables (see Figure 27) 1 = no print
IP(49)	Print/no-print indicator 0 = print complete common region variables (see Figure 26) 1 = no print
XMISC(24)	Maximum design weight for landing gear design

Mass Storage File Records

Record 11	Read D-array into first 1,400 cells of common
Record 19	Write DV array
Record 22	Write BC array

Error Messages

None

SUBROUTINE SPDALT

General Description

Deck name:	SPDALT
Entry name:	SPDALT
Called by:	DATAIN
Subroutines called:	TEMPRE

This subroutine expands the input speed-altitude profile data by interpolating between the input points. Profiles examined are level-flight maximum speed, M_H, and limit speed, M_L, envelopes with the wing fixed or in the aft position.

The limit speed at the input points is determined from the input M_H points and M_H-M_L relationship. This relationship is either given for each of the input points or specified as a general relationship, as shown in the following.

** TCOM AT END OF DATA MANAGEMENT LINK **   ** DATAIN - IP(49) **

*** VEHICLE GEOMETRY AND MISC DATA FILE ***

1	1.0000	2.0000	3.0000	4.0000	5.0000
6	6.0000	7.0000	8.0000	9.0000	10.0000
11	11.0000	12.0000	20.0000	1000.0000	3.1416
16	.0175	144.0000	24.0000	.5000	1.5000
21	.3333	.9500	.2500	0.0000	1.4142
26	32.1740	180.0000	1.7321	2.5000	1.3333
31	1.5000	1.2000	2.0000	0.0000	0.0000
81	36.0892	2116.2200	.0869	5.2559	65.6169
86	20.8056	472.6800	104.9869	114.3450	389.9700
91	-34.1634	.5486	18.1310	1.5362	411.5700
96	-12.2012	154.1995	518.6700	3.5662	389.9700
101	.0000	53.3000	1.4000	.0750	1.3500
106	.3000	.5000	460.0000	12.5300	15.6500
111	51.8000	.8000	.0500	400.0000	1.0191
116	.0289	1.3501	.6663	1.5000	.0060
121	.0807	3.1650	1.5885	1100.0000	2.5000
126	.7705	.1483	4.3718	2.1150	900.0000
131	1.5381	.3030	.4872	.4653	700.0000
141	1.6000	.9449	.0074	.0263	2000.0000
146	.9750	.9750	.9750	0.0000	0.0000
151	2.0000	10.0000	.5000	4.0000	1.5000
156	10.0000	.5000	1.0000	2.5000	12.0000
161	.0150	.4370	.1320	.7580	.6000
166	.2960	.0400	1.0500	1.3500	.2500
171	27.6700	1.0000	.4300	.4140	.1680
176	.8960	.0430	.1210	.0250	63.2700
181	1.0000	.4300	.3760	.1220	.8730
186	.3570	.4890	.0390	13.7200	1.0000
191	.4300	.4116	.7756	.2136	.2192
196	.8500	.1500	1.1240	.1720	.0470
201	.0650	.2410	.0520	1.0000	.5500
206	.4800	0.0000	.5320	.1280	.1240
211	.0380	.1780	.7240	.2740	.2900
216	.9000	.1000	.7000	.3300	.2500
221	.2000	.5000	500.0000	1.0500	.9800
226	1.0200	0.0000	0.0000	0.0000	0.0000
701	31.0000	0.0000	0.0000	0.0000	1.0000
706	0.0000	0.0000	1.0000	0.0000	0.0000
721	318000.0000	0.0000	316130.0000	931.6500	257500.0000
726	0.0000	30000.0000	12000.0000	0.0000	0.0000
731	2.5000	2.0000	-1.0000	2.0000	1.0000
736	-.5000	147.0000	103.0000	6.0000	10.0000
741	28.0000	12.0000	61.7000	41.5000	920.0000
746	991.7700	354.7500	96.0000	105.0000	0.0000

Figure 26. Sample output of complete common region variables.

751	.5740	.6800	.8140	.8500	.8500
756	0.0000	10000.0000	20000.0000	22500.0000	50000.0000
761	.0260	.0260	.0240	.0200	.0200
786	0.0000	0.0000	0.0000	8000.0000	0.0000
796	0.0000	3714.0000	0.0000	0.0000	18759.0000
801	0.0000	0.0000	0.0000	3577.0000	144.0000
806	212.0000	1380.0000	236.0000	320.0000	554.0000
811	1122.0000	1489.0000	2650.0000	2347.0000	0.0000
816	3320.0000	2648.0000	0.0000	95.0000	113.0000
821	860.0000	2164.0000	416.0000	0.0000	236.0000
836	0.0000	1121.8000	0.0000	0.0000	774.1000
841	0.0000	0.0000	0.0000	845.6700	803.9000
846	840.8000	953.4000	666.2000	768.3000	844.7000
851	545.0000	881.9000	657.5000	592.4000	0.0000
856	596.8000	809.9000	0.0000	1228.0000	300.0000
861	351.3000	1001.9000	753.6100	0.0000	852.9700
871	70000.0000	0.0000	0.0000	67640.0000	69040.0000
881	887.0000	0.0000	0.0000	858.0000	1047.3400
891	452.0000	1292.0000	0.0000	0.0000	78.0000
896	325.0000	615.0000	968.0000	0.0000	0.0000
911	1.0000	0.0000	0.0000	1.0000	1.0000
921	1.0000	0.0000	0.0000	.9719	1.0000
931	1.0000	0.0000	0.0000	.4153	.5728
941	320.0000	403.0000	1718.0000	4.0000	0.0000
951	3002.8300	8.5197	.4175	28.1090	0.0000
956	0.0000	77.7000	648.7600	0.0000	0.0000
961	284.0000	.1433	.6125	0.0000	0.0000
966	.3775	0.0000	0.0000	0.0000	0.0000
986	0.0000	92.0000	641.0000	.3230	50.0000
1001	483.0000	5.2480	.3609	25.0000	.2500
1006	0.0000	0.0000	1718.1700	0.0000	0.0000
1011	558.6600	.1050	1.0000	0.0000	0.0000
1016	.4000	0.0000	0.0000	0.0000	0.0000
1041	416.0000	1.2410	.6009	35.0000	.2500
1046	0.0000	0.0000	1544.8000	0.0000	0.0000
1051	286.0000	.1300	1.0000	0.0000	0.0000
1056	.4000	0.0000	0.0000	0.0000	0.0000
1081	1.0000	19.0000	0.0000	0.0000	0.0000
1086	230.4000	280.0000	350.0000	440.0000	1200.0000
1091	1300.0000	1400.0000	1520.0000	1680.0000	1817.9000
1096	200.0000	200.0000	200.0000	200.0000	230.0000
1101	225.0000	240.0000	252.0000	262.0000	270.0000
1106	0.0000	101.2000	150.2000	170.0000	170.0000
1111	168.0000	158.5000	133.7000	75.7000	0.0000
1116	0.0000	101.2000	150.2000	170.0000	170.0000
1121	168.0000	158.5000	133.7000	75.7000	0.0000
1126	0.0000	318.0000	472.0000	534.0000	534.0000
1131	528.0000	498.0000	420.0000	238.0000	0.0000
1136	272.0000	349.0000	353.0000	452.0000	600.0000
1141	732.0000	736.0000	866.0000	956.0000	[illegible]
1146	996.0000	1000.0000	1142.0000	1292.0000	1348.0000

Figure 26. Sample output of complete common region variables (cont).

1151	1639.0000	1643.0000	1724.0000	1730.0000	1817.9000
1161	4.0000	1.2000	2.0000	1648.0000	4.0000
1166	6.0000	4.0000	21000.0000	4690.0000	147.0000
1171	45.0000	88.2000	648.0000	285.0000	192.7100
1176	737.0000	440.0000	185.5200	0.0000	70.0000
1181	0.0000	171.0000	40.0000	171.0000	40.0000
1186	.1000	0.0000	0.0000	0.0000	0.0000
1201	1.0000	3.0000	0.0000	0.0000	0.0000
1211	0.0000	6.0000	12.0000	0.0000	0.0000
1241	47.0000	50.0000	52.5000	0.0000	0.0000
1251	47.0000	50.0000	52.5000	0.0000	0.0000
1261	147.7000	157.1000	165.0000	0.0000	0.0000
1291	2.0000	10.0000	0.0000	0.0000	0.0000
1296	0.0000	0.0000	0.0000	66.0000	66.0000
1301	0.0000	10.0000	20.0000	40.0000	50.0000
1306	120.0000	140.0000	160.0000	180.0000	199.2180
1331	48.0000	63.0000	66.0000	66.0000	66.0000
1336	65.5000	65.0000	63.5000	60.0000	56.0000
1341	48.0000	63.0000	66.0000	66.0000	56.0000
1346	65.5000	65.0000	63.5000	60.0000	56.0000
1351	150.7964	197.9203	207.3451	207.3451	207.3451
1356	205.7743	204.2035	199.4911	188.4956	169.6460
1401	0.0000	5000.0000	10000.0000	15000.0000	20000.0000
1406	21250.0000	22500.0000	30250.0000	50000.0000	0.0000
1411	518.6700	500.4392	483.0084	465.1776	447.3468
1416	447.8891	438.4314	389.9700	389.9700	0.0000
1421	2116.2200	1760.7946	1455.3302	1194.2672	972.4902
1426	922.6255	874.8517	469.0419	242.2114	0.0000
1431	32.1740	32.1588	32.1436	32.1284	32.1132
1436	32.1094	32.1056	32.0638	32.0220	0.0000
1441	1115.9020	1096.2940	1076.3476	1056.0437	1035.3613
1446	1030.1288	1024.8709	965.9420	965.3122	0.0000
1451	.0765	.0660	.0565	.0482	.0408
1456	.0391	.0374	.0226	.0117	0.0000
1461	.5740	.6238	.6900	.7426	.8160
1466	.8317	.8500	.8500	.8500	0.0000
1471	.6000	.6499	.7060	.7688	.8400
1476	.8548	.8700	.8700	.8700	0.0000
1481	488.0706	479.5659	471.0613	461.0595	451.0577
1486	446.7569	442.4562	237.2179	122.4984	0.0000
1491	533.2874	520.5299	507.7723	494.0523	480.3323
1496	471.9275	463.5227	248.5124	128.3308	64.4154
1501	.5000	.5000	.5000	.5000	.5000
1506	.5000	.5000	.5000	.5000	.2500
1511	.5000	.5000	.5000	.5000	.5000
1516	.5000	.5000	.5000	.5000	0.0000
1521	1.0000	1.0000	1.0000	1.0000	1.0000
1526	1.0000	1.0000	1.0000	1.0000	0.0000
1531	1.0000	1.0000	1.0000	1.0000	1.0000
1536	1.0000	1.0000	1.0000	1.0000	0.0000
1541	552.8479	539.8127	527.6770	516.4881	506.6288

Figure 26. Sample output of complete common region variables (cont).

1546	504.1626	501.7847	446.3207	446.3207	0.0000
1551	556.0142	563.1418	531.1582	520.1598	510.4766
1556	507.6148	504.8011	449.0037	449.0037	0.0000
1561	18.3738	15.8947	13.7736	11.9615	10.4346
1566	10.0839	9.7438	5.2240	2.6477	0.0000
1571	18.7448	16.2405	14.0942	12.2617	10.7197
1576	10.3276	9.9503	5.3348	2.7548	0.0000
1581	15.4895	13.3996	11.6114	10.0837	8.8008
1586	8.5009	8.2142	4.4039	2.2742	0.0000
1591	15.8022	13.6910	11.8817	10.3369	9.0369
1596	8.7064	8.3883	4.4073	2.3224	0.0000
1601	.7713	.7688	.7660	.7629	.7593
1606	.7584	.7575	.7575	.7575	0.0000
1611	.7700	.7675	.7647	.7616	.7580
1616	.7573	.7565	.7565	.7565	0.0000
1621	1.5640	1.5760	1.5869	1.5966	1.6049
1626	1.6069	1.6088	1.6467	1.6447	0.0000
1631	1.5610	1.5729	1.5838	1.5935	1.6017
1636	1.6041	1.6064	1.6435	1.6435	0.0000
1641	1.5187	1.5274	1.5342	1.5391	1.5416
1646	1.5421	1.5424	1.5748	1.5768	0.0000
1651	1.5143	1.5227	1.5294	1.5341	1.5364
1656	1.5374	1.5384	1.5739	1.5739	0.0000
1661	27.9049	24.2769	21.1315	18.4104	16.0934
1666	15.5500	15.0287	8.2371	4.2536	0.0000
1671	28.7357	25.0496	21.8570	19.0979	16.7543
1676	16.2038	15.6760	8.5919	4.4368	0.0000
1681	28.3853	24.7298	21.5558	18.8112	16.4697
1686	15.8781	15.3072	8.3063	4.3358	0.0000
1691	29.2605	25.5451	22.3222	19.5386	17.1697
1696	16.5663	15.9840	8.7676	4.5275	0.0000
1701	14.4335	12.4647	10.7779	9.3381	8.1255
1706	7.8207	7.5274	4.0357	2.0840	0.0000
1711	0.0000	.5740	.6000	488.0706	533.2874
1716	27.9049	28.3853	1.4521	14.0398	14.5645
1721	77.7000	28.1090	24.7665	648.7600	317.8707
1726	.4175	8.5197	3002.8300	159.9480	77.7000
1731	165.8988	254.0976	342.2064	430.4952	518.6940
1736	606.8928	695.0916	783.2904	871.4892	937.6383
1741	.3775	0.0000	0.0000	0.0000	0.0000
1761	0.0000	23.6379	929.4494	237.9687	959.6880
1766	28.1090	648.7600	317.8707	132.7002	25.9158
1771	296.5815	28.9845	22.4758	1718.1700	168.0750
1776	.3699	5.2480	483.0000	50.3466	0.0000
1781	0.0000	30.2080	60.4160	90.6239	120.8319
1786	151.0399	181.2479	211.4559	241.6639	271.8719
1791	294.5278	.4000	25.0000	1819.8208	123.2409
1796	1819.8208	123.2409	0.0000	0.0000	0.0000
1801	38.5947	32.6781	1525.7075	282.4780	.5887
1806	1.3217	462.1473	24.7147	23.9215	23.9215
1811	51.1870	78.4525	105.7180	137.9835	160.2491

Figure 26. Sample output of complete common region variables (cont).

1816	187.5146	214.7801	242.0456	269.3112	289.7603
1821	.4000	35.0000	1.0000	1700.8002	274.0326
1826	262.0785	558.6552	1928.7128	22.7213	273.1076
1831	200.0000	200.0000	200.0000	200.0000	200.0000
1836	200.0000	200.0000	200.0000	200.0000	200.0000
1841	200.0000	200.0000	200.0000	223.0000	239.7000
1846	259.4375	259.6875	264.6686	264.9007	270.0000
1851	42.4877	74.8588	75.5339	84.9887	84.9887
1856	84.9887	84.9887	84.9887	84.9887	84.9887
1861	84.9887	84.9887	84.9887	84.2366	79.3950
1866	45.3861	44.6655	25.3241	24.2219	0.0000
1871	42.4877	74.8588	75.5339	84.9887	84.9887
1876	84.9887	84.9887	84.9887	84.9887	84.9887
1881	84.9887	84.9887	84.9887	84.2366	79.3950
1886	45.3861	44.6655	25.3241	24.2219	0.0000
1891	42.4877	74.8588	75.5339	84.9887	84.9887
1896	84.9887	84.9887	84.9887	84.9887	84.9887
1901	84.9887	84.9887	84.9887	84.2366	79.3950
1906	45.3861	44.6655	25.3241	24.2219	0.0000
1911	66.6774	117.4500	118.5167	133.5000	133.5000
1916	133.5000	133.5000	133.5000	133.5000	133.5000
1921	133.5000	133.5000	133.5000	132.1200	124.6500
1926	71.1594	70.0219	39.6523	37.9264	0.0000
1931	66.6774	117.4500	118.5167	133.5000	133.5000
1936	133.5000	133.5000	133.5000	133.5000	133.5000
1941	133.5000	133.5000	133.5000	132.1200	124.6500
1946	71.1594	70.0219	39.6523	37.9264	0.0000
1951	66.6774	117.4500	118.5167	133.5000	133.5000
1956	133.5000	133.5000	133.5000	133.5000	133.5000
1961	133.5000	133.5000	133.5000	132.1200	124.6500
1966	71.1594	70.0219	39.6523	37.9264	0.0000
1971	258.1333	310.5000	351.0000	402.5000	526.0000
1976	666.0000	734.0000	791.0000	801.0000	958.0000
1981	978.0000	998.0000	1071.0000	1217.0000	1345.0000
1986	1518.5000	1641.0000	1684.5000	1728.0000	1759.3000
1991	41.6000	77.0000	4.0000	99.0000	148.0000
1996	132.0000	4.0000	110.0000	110.0000	4.0000
2001	36.0000	4.0000	142.0000	150.0000	106.0000
2006	241.0000	4.0000	93.0000	4.0000	87.9000
2011	7925.8184	30752.6201	1914.7426	50130.3823	79032.0000
2016	70488.0000	2136.0000	58740.0000	58740.0000	2136.0000
2021	19224.0000	2136.0000	75828.0000	70687.3667	54489.9947
2026	95317.6383	1147.8097	18603.3149	643.6173	6914.4204
2031	78494.5951	852616.2126	70894.7760	2003803.7339	1358414.9849
2036	2995343.0946	90767.9726	2496119.2455	2496119.2455	90767.9726
2041	816911.7531	90767.9726	3222243.0240	3369733.8663	2225188.9960
2046	3014428.4025	25378.9195	325909.4182	7664.1739	53661.2620
2051	.0346	.0768	.0734	0.0000	0.0000
2061	0.0000	0.0000	0.0000	.1105	.0353
2066	.0740	.0771	.0704	.0674	0.0000
2071	.0346	.0768	.0734	0.0000	0.0000

Figure 26. Sample output of complete common region variable (cont).

2081	0.0000	0.0000	0.0000	.1105	.0353
2086	.0740	.0771	.0704	.0674	0.0000
2091	42.4041	74.6732	75.3566	86.9887	46.9887
2096	86.9887	86.9887	86.9887	86.9887	86.9887
2101	84.9887	86.9887	86.9887	83.9695	70.3097
2106	45.2073	44.4792	25.1538	24.0584	0.0000
2111	266.7097	469.8000	474.0667	534.0000	534.0000
2116	534.0000	534.0000	534.0000	534.0000	534.0000
2121	534.0000	534.0000	534.0000	528.4800	498.6000
2126	284.6375	280.0875	158.6001	151.7056	0.0000
2131	84.8774	149.5000	150.8600	170.0000	170.0000
2136	170.0000	170.0000	170.0000	170.0000	170.0000
2141	170.0000	170.0000	170.0000	168.1600	158.6900
2146	90.5625	89.1125	50.4464	48.2526	0.0000
2151	84.8774	149.5000	150.8600	170.0000	170.0000
2156	170.0000	170.0000	170.0000	170.0000	170.0000
2161	170.0000	170.0000	170.0000	168.1600	158.6900
2166	90.5625	89.1125	50.4484	48.2526	0.0000
2171	5660.6666	17563.6994	17894.1715	22691.9931	22691.9931
2176	22691.9931	22691.9931	22691.9931	22691.9931	22691.9931
2181	22691.9931	22691.9931	22691.9931	22225.2667	19783.1137
2186	6447.2418	6242.7671	2001.9137	1831.4374	0.0000
2191	716077.7254	27683649.6132	0.0000	0.0000	0.0000
2206	0.0000	12000.0000	9.2339	170.0000	170.0000
2211	540.5540	1712.0178	2811.2542	3212.5871	3611.5428
2216	3611.5428	3611.5428	3611.5428	3611.5428	3611.5428
2221	3611.5428	3611.5428	3611.5428	3566.3929	3330.0059
2226	1936.6292	1004.0483	605.0304	302.0401	176.8699
2231	335.1730	1350.0923	1406.9604	2423.0436	3631.1047
2236	3257.7714	1807.1047	2814.1047	2814.1047	1807.1047
2241	1913.7714	1807.1047	3486.1047	3658.1964	2601.3378
2246	5808.3980	503.3575	876.5986	152.3534	377.1853
2251	335.1730	1350.0923	1406.9604	2423.0436	3631.1047
2256	3257.7714	1807.1047	2814.1047	2814.1047	1807.1047
2261	1913.7714	1807.1047	3486.1047	3658.1964	2601.3378
2266	5808.3980	503.3575	876.5986	152.3534	377.1853
2271	.0263	.0119	.0387	0.0000	0.0000
2281	23.4737	24.9881	26.2113	0.0000	0.0000
2291	.0263	.0119	.0387	0.0000	0.0000
2301	36.9250	39.2750	41.2500	0.0000	0.0000
2311	36.9250	39.2750	41.2500	0.0000	0.0000
2321	36.9250	39.2750	41.2500	0.0000	0.0000
2331	6.0000	6.0000	0.0000	0.0000	0.0000
2341	914.4000	466.3000	0.0000	0.0000	0.0000
2351	3.0000	9.0000	0.0000	0.0000	0.0000
2381	24.0000	31.5000	33.0000	33.0000	33.0000
2386	32.7500	32.5000	31.7500	30.0000	27.0000
2401	37.6991	49.4801	51.8363	51.8363	51.8363
2406	51.4436	51.0509	49.8728	47.1239	42.4115
2411	37.6991	49.4801	51.8363	51.8363	51.8363
2416	51.4436	51.0509	49.8728	47.1239	42.4115

Figure 26. Sample output of complete common region variables (cont).

2421	37.6991	49.4801	51.8343	51.8363	51.5363
2426	51.4436	51.0509	49.8728	47.1239	42.4115
2431	10.0000	10.0000	20.0000	20.0000	60.0000
2436	20.0000	20.0000	20.0000	19.2180	0.0000
2441	1743.5839	2026.3273	4146.9024	4146.9024	12343.5832
2446	4099.7785	4036.9466	3879.8470	3441.3823	0.0000
2451	24.0000	31.5000	33.0000	33.0000	33.0000
2456	32.7500	32.5000	31.7500	30.0000	27.0000
2461	24.0000	31.5000	33.0000	33.0000	33.0000
2466	32.7500	32.5000	31.7500	30.0000	27.0000
2471	24.0000	31.5000	33.0000	33.0000	33.0000
2476	32.7500	32.5000	31.7500	30.0000	27.0000
2481	5.0000	15.0000	30.0000	50.0000	90.0000
2486	130.0000	150.0000	170.0000	189.6090	0.0000
2491	385.0312	520.0312	544.5000	544.5000	540.3828
2496	532.1953	516.0078	476.6328	406.1250	0.0000
2501	200.8490	268.3490	305.5833	305.5833	570.1914
2506	299.4310	291.3372	271.6407	233.8401	0.0000
2511	200.8490	268.3490	305.5833	305.5833	570.1914
2516	299.4310	291.3372	271.6407	233.8401	0.0000
2521	31996.7324	3666.6409	2171.0398	31127.8764	8175.4425
2526	851.9806	3714.0000	6141.3791	0.0000	18759.0000
2531	0.0000	832.9170	0.0000	3577.6000	144.0000
2536	212.0000	1380.0000	236.0000	320.0000	554.0000
2541	1122.0000	1489.0000	2650.0000	2347.0000	0.0000
2546	3320.0000	2648.0000	0.0000	95.0000	113.0000
2551	860.0000	2164.0000	416.0000	0.0000	236.0000
2561	70000.0000	0.0000	0.0000	65739.9924	49040.0000
2571	981.6317	1846.8453	1749.9266	1054.7604	922.4237
2576	356.3802	1121.8000	795.6418	0.0000	774.1000
2581	0.0000	698.9870	0.0000	845.6700	803.9000
2586	840.8000	953.4000	666.2000	768.3000	844.7000
2591	545.0000	881.9000	657.5000	592.4000	0.0000
2596	596.8000	809.9000	0.0000	1228.0000	300.0000
2601	351.3000	1001.9000	753.6100	0.0000	852.9700
2611	887.0000	0.0000	0.0000	858.0000	1047.3400
2621	31127.8764	8175.4425	851.9806	123.1518	576.8691
2626	0.0000	0.0000	236.0000	0.0000	897.6000
2631	997.6300	1987.5000	2347.0000	0.0000	3320.0000
2636	2118.4000	0.0000	95.0000	113.0000	860.0000
2641	0.0000	0.0000	236.0000	0.0000	0.0000
2661	1054.7604	922.4237	356.3802	341.3000	153.7014
2666	0.0000	0.0000	666.2000	0.0000	467.2902
2671	989.5194	655.5333	592.4000	0.0000	596.8000
2676	818.8500	0.0000	1228.0000	300.0000	351.3000
2681	0.0000	0.0000	852.9700	0.0000	0.0000
2701	31996.7324	0.0000	1724.1257	1380.0000	112.2000
2706	2164.0000	0.0000	0.0000	0.0000	0.0000
2721	981.6317	0.0000	981.6317	953.4000	937.5786
2726	1001.9000	0.0000	0.0000	0.0000	0.0000
2741	3666.6409	887.9895	0.0000	0.0000	0.0000

Figure 26. Sample output of complete common region variables (cont).

2751	1846.8453	1846.8453	0.0000	0.0000	0.0000
2761	2171.0398	401.8639	0.0000	0.0000	0.0000
2771	1749.9266	1749.9266	0.0000	0.0000	0.0000
2781	3070.6890	9379.5000	0.0000	416.4585	0.0000
2786	1788.5000	72.0000	106.0000	160.0000	277.0000
2791	56.1000	245.6850	331.2500	264.8000	208.0000
2801	751.1418	729.6000	-44.5000	654.4870	-44.5000
2806	801.1700	759.4000	796.3000	723.8000	800.2000
2811	729.6000	618.9000	618.9000	729.6000	709.1100
2821	3070.6890	9379.5000	0.0000	416.4585	0.0000
2826	1788.5000	72.0000	106.0000	160.0000	277.0000
2831	56.1000	245.6850	331.2500	264.8000	208.0000
2841	840.1418	818.6000	44.5000	743.4870	44.5000
2846	890.1700	848.4000	885.3000	812.8000	889.2000
2851	818.6000	707.9000	707.9000	818.6000	798.1100
2856	89.0000	89.0000	89.0000	89.0000	89.0000
2861	192.6266	777.2470	50.1207	1390.2452	2089.7796
2866	2546.7246	81.9734	2364.9121	2578.4367	97.7868
2871	892.7686	100.6082	3754.5178	4343.5333	2617.8213
2876	4757.2784	62.7993	1142.1034	47.0669	839.6297
2881	1749.9452	1187.6249	79.6559	2426.4963	1948.5106
2886	3660.8430	4.4129	1808.3106	6640.2608	220.6550
2891	2136.9276	2.6145	90.9527	178.9799	180.3127
2896	137.7261	2.1526	254.3403	10.9555	213.8898
2901	0.0000	77.7000	165.8088	254.0976	342.2966
2906	430.4952	518.6960	606.8928	695.0916	783.2904
2911	871.4892	937.6383	959.6880	165.8988	845.2873
2916	165.8988	845.2873	0.0000	0.0000	0.0000
2921	38.8500	121.7996	209.9002	298.1970	386.3958
2926	474.5946	562.7934	650.9022	739.1910	827.3898
2931	904.5637	948.6631	831.8056	867.7439	905.9567
2936	944.1696	982.3825	1020.5953	1058.8082	1097.0210
2941	1135.2339	1173.4468	1206.8830	1225.9894	38.8500
2946	121.7996	209.9982	298.1070	386.3958	474.5946
2951	562.7934	650.9922	739.1010	827.3898	906.5637
2956	948.6631	640.0712	771.4547	757.6215	744.6118
2961	732.4257	721.0631	710.5240	700.8086	691.9163
2966	683.8477	393.8529	66.3615	5276.6937	4744.7234
2971	4211.9856	3710.9623	3241.6561	2804.0608	2398.1825
2976	2024.0190	1681.5705	1370.8369	1124.9611	995.3627
2981	5640.8375	5269.7736	4750.8605	4262.8551	3805.7330
2986	3379.5026	2944.1631	2619.7153	2286.1588	1933.6939
2991	1660.3921	1010.0327	3806.1178	4121.0459	3698.0069
2996	3661.3895	3408.3586	3136.9263	2835.1633	2699.5336
3001	2110.7456	1629.9797	780.0323	111.4332	831.8054
3006	867.7439	905.9567	944.1696	982.3825	1020.5953
3011	1058.8082	1097.0210	1135.2339	1173.4468	1206.8830
3016	1225.9894	4446.1254	30613.2029	27025.0201	23666.2232
3021	3981.4820	17156.6556	14440.7320	11902.6180	9522.1147
3026	7253.8748	3938.7486	130.1709	831.8039	828.3276
3031	869.3146	910.2870	992.3813	983.7851	1025.6541

Figure 26. Sample output of complete common region variables (cont).

3036	1067.0140	1108.3769	1149.3139	1184.0980	1225.9888
3041	4446.1254	20888.5910	26393.7041	23102.1434	3951.6820
3046	17156.6556	14440.7320	11902.6180	9522.1167	7253.8764
3051	3938.7486	130.1709	831.8039	828.5059	869.4919
3056	910.4641	982.3813	983.7851	1025.4541	1067.0140
3061	1108.3769	1149.3139	1184.0980	1225.9888	4446.1254
3066	15528.1113	13885.6058	12320.8183	3941.4820	11391.7383
3071	9688.4705	8065.1528	6507.5042	4968.4236	2645.3713
3076	130.1709	831.8039	835.4794	876.3401	917.1649
3081	982.3813	988.8602	1030.3258	1071.6547	1112.7239
3086	1153.2647	1187.4507	1225.9888	831.8039	828.3276
3091	869.3146	910.2879	982.3813	983.7851	1025.4541
3096	1067.0140	1108.3769	1149.3139	1184.0980	1225.9888
3101	831.8039	828.3276	869.3146	910.2879	982.3813
3106	983.7851	1025.4541	1067.0140	1108.3769	1149.3139
3111	1184.0980	1225.9888	38.8500	121.7994	209.9982
3116	298.1970	386.3958	474.5946	562.7934	650.9922
3121	739.1910	827.3898	904.5637	948.6631	38.8500
3126	121.7994	209.9982	298.1970	386.3954	474.5946
3131	562.7934	650.9922	739.1910	827.3898	904.5637
3136	948.6631	831.8039	828.5059	869.4919	910.4641
3141	982.3813	983.7851	1025.4541	1067.0140	1108.3769
3146	1149.3139	1184.0980	1225.9888	831.8034	828.5059
3151	869.4919	910.4641	982.3813	983.7851	1025.4541
3156	1067.0140	1108.3769	1149.3139	1184.0980	1225.9888
3161	38.8500	121.7994	209.9982	298.1970	346.3958
3166	474.5946	562.7934	650.9922	739.1910	827.3898
3171	904.5637	948.6631	38.8500	121.7994	209.9982
3176	298.1970	386.3958	474.5946	562.7934	650.9922
3181	739.1910	827.3898	904.5637	948.6631	831.8039
3186	835.4794	876.3401	917.1649	982.3813	988.8602
3191	1030.3258	1071.6547	1112.7239	1153.2647	1187.4507
3196	1225.9888	831.8039	835.4794	876.3401	917.1649
3201	982.3813	988.8602	1030.3258	1071.6547	1112.7239
3206	1153.2647	1187.4507	1225.9888	38.8500	121.7994
3211	209.9982	298.1970	386.3958	474.5946	562.7934
3216	650.9922	739.1910	827.3898	904.5637	948.6631
3221	38.8500	121.7994	209.9982	298.1970	346.3954
3226	474.5946	562.7934	650.9922	739.1910	827.3898
3231	904.5637	948.6631	23451949.5717	141813097.1566	111170274.9295
3236	85731182.8119	129065587.5689	48108305.8083	34631510.3174	26091125.1277
3241	16012107.0158	9943879.1021	4430938.7820	129567.2946	23451949.5717
3246	141813097.1566	111170274.9295	85731182.8119	129065587.5689	48108305.8083
3251	34631510.3174	26091125.1277	16012107.0158	9943879.1021	4430938.7820
3256	129567.2946	23451949.5717	145251607.0967	113829094.4243	87750242.3231
3261	129065587.5689	48108305.8083	34631510.3174	26091125.1277	16012107.0158
3266	9943879.1021	4430938.7820	129567.2946	23451949.5717	73676593.0431
3271	58485968.4154	45722591.8149	129065587.5689	31943126.9475	23229423.7772
3276	16324022.5965	10942466.9632	6410898.2965	2975939.8393	129567.2946
3301	1749.9452	1187.6249	70.6554	7033.9264	10055.2562
3306	12123.5203	278.4950	9777.4601	15416.2986	554.9878

Figure 26. Sample output of complete common region variables (cont).

3311	5193.9362	347.6160	13029.7050	15307.1722	180.3127
3316	137.7261	2.1526	254.3403	10.9555	213.8898
3321	1749.9452	1187.6249	79.6559	7033.9246	10055.2542
3326	12123.5203	278.9959	9777.4491	15416.2986	554.9878
3331	5193.9362	347.6160	13029.7050	15307.1722	180.3127
3336	137.7261	2.1526	254.3403	10.9555	213.8898
3341	1749.9452	1187.6249	79.6559	7033.9246	10055.2542
3346	12123.5203	278.9959	9777.4491	15416.2986	554.9878
3351	5193.9362	347.6160	13029.7050	15307.1722	180.3127
3356	137.7261	2.1526	254.3403	10.9555	213.8898
3361	70000.0000	0.0000	0.0000	67640.0000	69040.0000
3371	70000.0000	0.0000	0.0000	28089.9992	28089.9992
3381	77.7000	165.8988	254.0076	342.2964	430.4952
3386	518.6940	606.8928	695.0916	783.2904	871.4892
3391	937.6383	.0000	645.8188	629.7834	591.5542
3396	550.6731	506.4959	458.0445	403.8393	341.0236
3401	263.3485	126.0263	18.0038	0.0000	15.1040
3406	45.3120	75.5200	105.7279	135.9359	166.1439
3411	196.3519	226.5599	256.7479	293.1998	298.3038
3416	1800.5652	1806.3362	1817.8782	1829.4202	1840.9622
3421	1852.5042	1864.0462	1875.5882	1887.1301	1898.6721
3426	1908.7714	1914.5424	.0000	376.1200	355.7637
3431	334.1680	311.0744	286.1187	258.7599	228.1274
3436	192.6437	148.7651	71.1021	10.1703	0.0000
3441	13.6328	40.8983	68.1638	95.4293	122.6949
3446	149.9604	177.2259	204.4914	231.7569	255.6143
3451	269.2470	1684.5888	1692.7362	1709.0311	1725.3259
3456	1741.6208	1757.9157	1774.2105	1790.5054	1806.8003
3461	1823.0951	1837.3531	1845.5006	318000.0076	931.2100
3466	931.2100	249.3668	0.0000	23307491058.0784	55098864305.4387
3471	316100.0000	931.6500	931.6500	249.1586	0.0000
3476	0.0000	23285348948.9281	23285348948.9281	58452727891.8137	58452727891.8137
3481	257500.0060	0.0000	933.0062	241.2297	0.0000
3486	22386372337.7302	47184851804.2092	4554.6304	1866.8453	100.6933
3491	0.0000	7148039.4048	76418065.5216	14375.9825	737.0857
3496	0.0000	57868111.9310	57868111.9310	14375.9825	826.0857
3501	0.0000	57868111.9310	57868111.9310	0.0000	0.0000
3521	318000.0076	931.2100	931.2100	314100.0000	931.6500
3526	931.6500	5025908.0586	5025908.0586	12614432.6247	12614432.6247
3531	257500.0060	933.0062	2.5000	2.0000	-1.0000
3536	2.0000	1.0000	-.5000	0.0000	20030.0000
3541	22500.0000	.5740	.8140	.8500	0.0000
3551	147.0000	103.0000	230.4000	221.6000	3005209.3074
3556	84.9887	77.7000	28.1300	24.7645	648.7600
3561	317.8707	.4175	8.5107	3002.8300	159.9480
3566	77.7000	165.8988	254.0076	342.2964	430.4952
3571	518.6940	606.8928	695.0916	783.2904	871.4892
3576	937.6383	.3775	0.0000	0.0000	0.0000
3616	0.0000	0.0000	0.0000	0.0000	92.0000
3621	641.0000	.3230	50.0000	296.5815	28.9845
3626	22.4758	1718.1700	148.0750	.3699	5.2480

Figure 26. Sample output of complete common region variables (cont).

3631	483.0000	50.3666	0.0000	0.0000	30.2080
3636	60.4160	90.6239	120.8319	151.0399	181.2479
3641	211.4559	241.6639	271.8718	294.5278	.4009
3656	0.0000	38.5947	32.6781	1525.7075	282.4780
3661	.5887	1.3217	442.1473	24.7147	23.9215
3666	23.9215	51.1870	78.4525	105.7190	132.9835
3671	160.2491	187.5144	214.7801	242.0456	269.3112
3676	289.7603	.4000	242.0785	0.0000	0.0000
3686	.6000	.8400	.8700	30000.0000	12000.0000
3691	165.8988	1.0000	.8097	.4130	-28384476.1050
3696	-20140471.4359	-10650689.9949	-22091670.2451	-15664984.6504	-7757703.0820
3706	-0.0000	318000.0076	257500.0060	0.0000	0.0000
3721	77.7000	165.8988	254.0976	342.2964	430.4952
3726	518.6940	606.8928	695.0916	783.2904	871.4892
3731	937.6383	.4183	.9080	.4613	11.0248
3736	24.6886	937.6383	1201.3002	-265144.4149	-1151489.9287
3741	8187.9913	56.1000	1.0000	2.0000	77.7000
3746	165.8988	256.0974	342.2964	430.4952	518.6940
3751	606.8928	695.0914	783.2904	871.4892	937.6383
3756	33820.0000	32869.9962	858.0000	78.0000	325.0000
3761	24520.0000	24520.0000	1047.3400	415.0000	968.0000
3766	8187.9913	285.0000	737.0857	0.0000	0.0000
3771	30.2080	60.4160	90.6239	120.8319	151.0399
3776	181.2479	211.4559	241.6639	271.8718	294.5278
3781	302.0798	1785.4000	1785.4000	1797.8976	1810.3952
3786	1822.8927	1835.3903	1847.8879	1860.3854	1872.8830
3791	1885.3806	1897.8782	1907.2513	1910.3757	0.0000
3796	0.0000	27.2655	54.5310	81.7966	109.0621
3801	136.3276	163.5931	190.8586	218.1242	245.3897
3806	265.8388	272.6552	1654.0430	1654.0430	1671.5324
3811	1689.0219	1706.5113	1724.0007	1741.4901	1758.9795
3816	1776.4689	1793.9583	1811.6477	1824.5647	1828.9371
3821	318000.0076	2.5000	-1.0000	-182362.8977	-151749.6048
3826	-124724.5867	-84702.3790	-80720.8070	-67188.2589	-32747.5268
3831	-20844.9089	-11322.7962	-4068.9104	-130.1709	-60453111.3425
3836	-44183340.4902	-30714604.0335	-21461360.3539	-13769477.6853	-8910170.6987
3841	-5145737.2704	-2453223.1352	-896472.1058	-152390.6242	-2649.3391
3846	-4479743.6933	-4570807.6685	-4661198.4486	-2320475.6105	-2448371.8881
3851	-84520.1387	-44158.0874	-23970.6528	-12063.1629	-4637.5864
3856	2317.0453	-14095.3073	-12034.7844	-10085.7809	-8255.0861
3861	-6550.9069	-4983.4437	-3565.8620	-2316.0953	-1240.7226
3866	-445.7328	-55.7166	-5691115.9833	-4385150.0203	-3277928.6130
3871	-2354166.4895	-1613849.9848	-1032073.4285	-598802.4369	-298507.1881
3876	-113532.5984	-22803.6830	-1134.0014	436652.4674	356572.0361
3881	285204.6916	222282.6641	167537.9509	120706.8385	81538.7214
3886	49815.3202	25397.4995	8372.4419	991.7877	-14095.3073
3891	-12034.7844	-10085.7809	-8255.0841	-6550.9069	-4983.4437
3896	-3565.8620	-2316.0953	-1240.7226	-445.7328	-55.7164
3901	-5641115.9833	-4385150.0203	-3277928.6130	-2358166.4895	-1613849.9848
3906	-1032073.4285	-598802.4369	-298507.1881	-113532.5984	-22803.6830
3911	-1134.0014	436652.4674	356572.0361	285204.6916	222282.6641

Figure 26. Sample output of complete common region variables (cont).

3916	167537.9599	120706.8385	81538.7214	40815.3202	25397.4995
3921	8372.4419	991.7877	-91191.4489	-75874.8026	-62342.2926
3926	-42351.1895	-40360.4485	-23594.1294	-16373.7634	-10422.4544
3931	-5661.3971	-2034.4597	-65.0855	-30226555.6712	-22091670.2451
3936	-15357252.0167	-10930690.1769	-6884238.8426	-4455085.3494	-2572868.6352
3941	-1226611.5976	-448236.0529	-76194.8121	-1324.6696	-2238371.8467
3946	-2285403.8342	-2330599.2342	-1160237.8052	-1224185.9441	-42260.0693
3951	-23079.0438	-11985.3266	-6031.5714	-2318.7932	1158.5227
3956	-90231.4451	-75287.1495	-62090.2525	-42351.1895	-40360.4485
3961	-23594.1294	-16373.7634	-10422.4544	-5661.3971	-2034.4597
3966	-65.0855	-30098612.6382	-22037601.7438	-15344440.4040	-10930690.1769
3971	-6884238.8426	-4455085.3494	-2572868.6352	-1226611.5976	-448236.0529
3976	-76194.8121	-1324.6696	-2235125.6925	-2283464.1798	-2329731.7724
3981	-1160237.8052	-1224185.9441	-42260.0693	-23079.0438	-11985.3264
3986	-6031.5714	-2318.7932	1158.5227	-90231.4451	-75287.1495
3991	-62090.2525	-42351.1895	-40360.4485	-23594.1294	-16373.7634
3996	-10422.4544	-5661.3971	-2034.4597	-65.0855	-30098612.6382
4001	-22037601.7438	-15344440.4040	-10930690.1769	-6884238.8426	-4455085.3494
4006	-2572868.6352	-1226611.5976	-448236.0529	-76194.8121	-1324.6696
4011	-2235125.6925	-2283464.1798	-2329731.7724	-1160237.8052	-1224185.9441
4016	-42260.0693	-23079.0438	-11985.3264	-6031.5714	-2318.7932
4021	1158.5227	-60931.4480	-53147.3024	-44224.5895	-31876.1091
4026	-29865.4481	-16001.5877	-11159.3524	-7125.7760	-3871.9829
4031	-1387.7711	-65.0855	-21240596.7524	-15664984.6504	-10806807.3110
4036	-7464367.8419	-4635376.1067	-3066904.9763	-1743917.5529	-851566.1823
4041	-313405.4051	-55024.0423	-1324.6606	-2056139.8805	-2130347.5850
4046	-2197881.4311	-1065576.8330	-1109524.9718	36028.8539	27469.9632
4051	17993.7553	9219.0316	2849.8302	1158.5227	-2277.3152
4056	-1944.4058	-1629.5141	-1333.7370	-1058.4005	-805.1525
4061	-576.1202	-374.2011	-203.6803	-72.0150	-9.0019
4066	-308382.7650	-237507.0538	-177436.2956	-127555.5249	-87210.4284
4071	-55697.6780	-32252.3290	-16027.6064	-6060.2805	-1199.2156
4076	-56.5002	23869.6268	19331.4436	15335.8788	11844.0039
4081	8836.5654	6294.0110	4196.8123	2526.1748	1265.9561
4086	409.0455	47.6532	-2572.9036	-2196.7836	-1841.0200
4091	-1506.8519	-1195.7775	-909.6588	-650.8989	-422.7712
4096	-238.1275	-81.3624	-10.1703	-369962.3546	-296629.0432
4101	-215708.1882	-154512.5030	-108311.6521	-70322.9277	-41697.9447
4106	-21502.4323	-4682.5815	-1999.6434	-144.1371	55778.6446
4111	46297.3514	37686.9123	29935.1398	23031.8507	16970.0538
4116	11748.0627	7373.6315	3873.3144	1319.8448	160.5068
4221	15	4	14	20	0
4226	150	3	141	0	0
4231	4	2	0	0	19
4236	1	3	1	10	2

Figure 26. Sample output of complete common region variables (concl).

*** BC ARRAY --- LOADS DATA - - RECORD 22 *** ** DATAIN - IP(47) **

1	318000.0076	931.2100	931.2100	316100.0000	931.6500
6	931.6500	5025908.0586	5025908.0586	12616432.6247	12616432.6247
11	257500.0060	933.0062	2.5000	2.0000	-1.0000
16	2.0000	1.0000	-.5000	0.0000	20000.0000
21	22500.0000	.5740	.8140	.8500	0.0000
26	0.0000	0.0000	0.0000	0.0000	0.0000
31	147.0000	103.0000	230.4000	221.6000	3005209.3076
36	84.9887	77.7000	28.1090	24.7645	648.7600
41	317.8707	.4175	8.5197	3002.8300	159.9480
46	77.7000	165.8988	254.0976	342.2964	430.4952
51	518.6940	606.8928	695.0916	783.2904	871.4892
56	937.6383	.3775	0.0000	0.0000	0.0000
61	0.0000	0.0000	0.0000	0.0000	0.0000
66	0.0000	0.0000	0.0000	0.0000	0.0000
71	0.0000	0.0000	0.0000	0.0000	0.0000
76	0.0000	0.0000	0.0000	0.0000	0.0000
81	0.0000	0.0000	0.0000	0.0000	0.0000
86	0.0000	0.0000	0.0000	0.0000	0.0000
91	0.0000	0.0000	0.0000	0.0000	0.0000
96	0.0000	0.0000	0.0000	0.0000	92.0000
101	641.0000	.3230	50.0000	296.5815	28.9845
106	22.4758	1718.1700	168.0750	.3699	5.2480
111	483.0000	50.3466	0.0000	0.0000	30.2080
116	60.4160	90.6239	120.8319	151.0399	181.2479
121	211.4559	241.6639	271.8719	294.5278	.4000
126	0.0000	0.0000	0.0000	0.0000	0.0000
131	0.0000	0.0000	0.0000	0.0000	0.0000
136	0.0000	38.5947	32.6781	1525.7075	282.4780
141	.5887	1.3217	462.1473	24.7147	23.9215
146	23.9215	51.1870	78.4525	105.7180	132.9835
151	160.2491	187.5146	214.7801	242.0456	269.3112
156	289.7603	.4000	262.0785	0.0000	0.0000
161	0.0000	0.0000	0.0000	0.0000	0.0000
166	.6000	.8400	.8700	30000.0000	12000.0000
171	165.8988	1.0000	.8097	.4130	-28384476.1050
176	-20148471.4359	-10650689.9949	-22091670.2451	-15664984.6504	-7757703.0820
181	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
186	-0.0000	318000.0076	257500.0060	0.0000	0.0000
191	0.0000	0.0000	0.0000	0.0000	0.0000
196	0.0000	0.0000	0.0000	0.0000	0.0000

Figure 27. Sample output of BC array variables.

Input M_H-M_L Relationship	Description
0.0	M_L equal to M_H
>0.0; <1.0	Decimal to be added to M_H
>1.0	Multiplier of M_H
<0.0	Fraction of M_H to be added to M_H

M_H and M_L data are input at five altitudes. Intermediate altitudes are obtained by taking points midway between the input altitudes, thus defining nine altitudes. Subroutine TEMPRE is called to calculate atmospheric properties at each of these altitudes. Dynamic pressure is then calculated for the input points. Dynamic pressure at the interpolated altitudes is obtained by interpolating between dynamic pressure at the input points, and speed is determined for the dynamic pressure and altitude.

Pressure recovery ratio and airflow at the engine is either input or calculated for the initial five points. Values at the four additional points are obtained by interpolation.

Having determined mach number, pressure recovery ratio, and airflow at the engine for the nine profile points, total temperature, total pressure, and static pressure are then calculated.

Additional calculations are made to determine the maximum cabin pressure differential. If the number of vehicle landings is not input data, a rule-of-thumb value of 2,000 is stored in the input data location for figheters and attack vehicles, and 12,000 for other vehicle categories.

Arrays and Variables Used

DATM	Speed-altitude profile data (refer to Table 29)
DVLG	General relationship between limit speed and maximum level speed (DATM)
EQU	Equation and physical constants (refer to Table 39)
GDI(1)	Vehicle class 11.0 = fighters and attack 21.0 = bombers 31.0 = transports for wheeled vehicles >100k 32.0 = transports for wheeled vehicles <100k 33.0 = transports for bulk cargo >100k 34.0 = transports for bulk cargo <100k 35.0 = transports for personnel >100k 36.0 = transports for personnel <100k

GDD(8) Number of landings
RATG General pressure recovery ratio (DATM)
S(1) TEMALT, ambient temperature at altitude, ° R
S(2) PRESH, ambient pressure at altitude, lb/ft^2

Arrays and Variables Calculated

ALT Nine altitudes on speed profile, ft
ALTT S(4), altitude, ft
CS Speed of sound at the nine speed profile altitudes, ft/sec
EMH Airflow at engine on M_H diagram, M
EML Airflow at engine on M_L diagram, M
G Acceleration of gravity at nine speed profile altitudes, ft/sec^2
PO Ambient pressure at nine speed profile altitudes, $lb/in.^2$
PSH Static pressure absolute at engine on M_H diagram, $lb/in.^2$
PSL Static pressure absolute at engine on M_L diagram, $lb/in.^2$
PTH Total pressure at engine on M_H diagram, $lb/in.^2$
PTL Total pressure at engine on M_L diagram, $lb/in.^2$
QH Dynamic pressure on M_H diagram, lb/ft^2
QL Dynamic pressure on M_L diagram, lb/ft^2
RATH Inlet pressure recovery ratio on M_H diagram
RATL Inlet pressure recovery ratio on M_L diagram
RHO Density of air at nine speed profile altitudes, lb/ft^3
TEM Ambient temperature at nine speed profile altitudes, ° R
TEMH Total temperature on M_H diagram, ° R
TEML Total temperature on M_L diagram, ° R
TOT(17) Number of occurrences of maximum cabin pressure differential
TOT(18) Maximum cabin pressure differential, psf
VH Level-flight maximum speed, M_H, at nine speed profile altitudes, M
VL Limit speed, M_L, at nine speed profile altitudes, M

Scratch Arrays and Variables

I Scratch counter
J Scratch counter
N Scratch counter
S(5) Factor for rule-of-thumb estimate of number of landings

Labeled Common Arrays

IP(42)	Print/no-print indicator 0 = print speed-altitude profile data (see Figure 28) 1 = no print
XMISC(85)	TITLE(1) Case title
XMISC(100)	TITLE(16)

Mass Storage File Records

None

Error Messages

None

SUBROUTINE TEMPRE

General Description

Deck name:	TEMPRE
Entry name:	TEMPRE
Called by:	SPDALT
Subroutines called:	None

This subroutine calculates standard atmosphere temperature and pressure by using equation representations which are functions of geopotential altitude. Altitude at which pressure and temperature are to be calculated is stored in location S(4) by the calling routine.

Arrays and Variables Used

EQU	Equation and physical constants (refer to Table 39)
S(4)	ALTT, altitude, ft

Arrays and Variables Calculated

S(1)	TEMALT, ambient temperature at ALTT, ° R
S(2)	PRESH, ambient pressure at ALTT, ° R

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*** SPEED ALTITUDE PROFILE TABLES ***

STANDARD ATMOSPHERE

ALTITUDE FEET	TEMPERATURE DEG RANKINE	DENSITY PCF	PRESSURE PSF	G FT/SEC SQ	SPEED OF SOUND FT/SEC
0.0	518.670	.0765495	2116.22	32.174	1115.90
5000.0	500.839	.0659604	1760.79	32.159	1096.29
10000.0	483.008	.0565301	1455.33	32.144	1076.35
15000.0	465.178	.0481677	1194.27	32.128	1056.04
20000.0	447.347	.0407862	972.49	32.113	1035.36
21250.0	442.889	.0390844	922.63	32.109	1030.13
22500.0	438.431	.0374374	874.85	32.106	1024.87
36250.0	389.970	.0225659	469.04	32.064	965.94
50000.0	389.970	.0116530	242.21	32.022	965.31

PROFILE TABLE

ALT. FEET	V(H) MN	Q(H) PSF	M2 MN	PT2/PTO	RAM T DEG R	PT2 PSI	P2 PSI	V(1) MN	Q(1) PSF	M2 MN	PT2/PTO	RAM T DEG R	PT2 PSI	P2 PSI
0.0	.57	488.07	.50	1.0000	552.85	18.37	15.49	.60	533.29	.50	1.0000	556.01	18.74	15.80
5000.0	.62	479.57	.50	1.0000	539.81	15.89	13.40	.65	520.53	.50	1.0000	543.14	16.24	13.69
10000.0	.68	471.06	.50	1.0000	527.68	13.77	11.61	.71	507.77	.50	1.0000	531.16	14.09	11.88
15000.0	.74	461.06	.50	1.0000	516.49	11.96	10.08	.77	494.05	.50	1.0000	520.16	12.26	10.36
20000.0	.81	451.06	.50	1.0000	506.63	10.44	8.80	.84	480.33	.50	1.0000	510.48	10.72	9.06
21250.0	.83	446.76	.50	1.0000	504.16	10.08	8.50	.85	471.93	.50	1.0000	507.61	10.33	8.71
22500.0	.85	442.46	.50	1.0000	501.78	9.74	8.21	.87	463.52	.50	1.0000	504.80	9.95	8.39
36250.0	.85	237.22	.50	1.0000	446.32	5.22	4.40	.87	248.51	.50	1.0000	449.00	5.33	4.50
50000.0	.85	122.50	.50	1.0000	446.32	2.70	2.27	.87	128.33	.50	1.0000	449.00	2.75	2.32

Figure 28. Sample output of atmospheric properties and speed-altitude profile data.

Scratch Arrays and Variables

S(3) ALOFT, altitude divided by 1,000, ft/1,000

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

```
*** WARNING MESSAGE ***
ALTITUDE IS BEYOND VALID RANGE OF PRESSURE

*** WARNING MESSAGE ***
ALTITUDE IS BEYOND VALID RANGE OF TEMPERATURE
```

These messages are printed for altitude greater than 154,199.48 feet. The pressure and temperature are calculated by the equation for the highest altitude range.

SUBROUTINE DSGNPR

General Description

Deck name:	DSGNPR
Entry name:	DSGNPR
Called by:	DATAIN
Subroutines called:	None

This subroutine calculates static pressure at the inlet throat and hammershock pressures at both the engine face and the throat for points on the level-flight maximum speed and limit speed envelopes. Calculated pressures are scanned for the maximum static and hammershock pressures.

Arrays and Variables Used

ALT	Nine altitudes on speed profile, ft
EGTP	Engine type 0.0 = turbojet +X.X = fanjet bypass ratio
EQU	Equation and physical constants (refer to Table 39)
IVG	Inlet-type indicator 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translatable spike 6 = expandable spike
PO	Ambient pressure at nine speed profile altitudes, lb/ft^2
PSL	Static pressure absolute at engine on M_L diagram, psia
PTH	Total pressure at engine on M_H diagram, psia
PTL	Total pressure at engine on M_L diagram, psia
QH	Dynamic pressure on M_H diagram, lb/ft^2
QL	Dynamic pressure on M_L diagram, lb/ft^2
RATL	Inlet pressure recovery ratio on M_L diagram
TEMH	Total temperature on M_H diagram, ° R
TEML	Total temperature on M_L diagram, ° R
VH	Level-flight maximum speed, M_H, at nine speed profile altitudes, M
VL	Limit speed, M_L, at nine speed profile altitudes, M

Arrays and Variables Calculated

DSP	Design pressure data (refer to Table 33)
PHEH	Hammershock pressure at engine on M_H diagram, $lb/in.^2$
PHEL	Hammershock pressure at engine on M_L diagram, $lb/in.^2$
PHTH	Hammershock pressure at throat on M_H diagram, $lb/in.^2$
PHTL	Hammershock pressure at throat on M_L diagram, $lb/in.^2$
PST	Static pressure at throat on M_L diagram, $lb/in.^2$
R1H	Ratio of static pressure at throat to free-stream total pressure on M_H diagram
R1L	Ratio of static pressure at throat to free-stream total pressure on M_L diagram
R2H	Ratio of hammershock pressure at engine face to total pressure on M_H diagram
R2L	Ratio of hammershock pressure at engine face to total pressure on M_L diagram
R3H	Ratio of hammershock pressure at inlet throat to total pressure on M_H diagram
R3L	Ratio of hammershock pressure at inlet throat to total pressure on M_L diagram

Scratch Arrays and Variables

I	Scratch counter
J	Scratch counter
N	Scratch counter
S(1)	Intermediate calculation
S(2)	Intermediate calculation
S(3)	Intermediate calculation
S(4)	Intermediate calculation
S(51)	Gage pressure

Mass Storage File Records

None

Labeled Common Arrays

IP(42)	Print/no-print indicator 0 = print inlet pressure data (see Figure 29) 1 = no print
XMISC(85)	TITLE(1) Case title
XMISC(100)	TITLE(16)

Error Messages

```
*** WARNING MESSAGE ***
RAM TEMPERATURE EXCEEDED FOR FANJET BPR = XXX.X
RAM TEMP = YYY.Y LIMIT = ZZZ.Z

*** WARNING MESSAGE ***
SPEED EXCEEDED FOR ENGINE INLET COMBINATION
BPR = XXX.X INLET TYPE = I SPEED = YYY.Y LIMIT = ZZZ.Z
```

These messages are printed when the conditions from which the pressure calculation curves were formulated are exceeded. YYY.Y designates the actual value, and ZZZ.Z designates the applicable range of the data base.

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SPEED PROFILE DESIGN CONSTANTS

BYPASS RATIO = 1.20   IVG = 2

ALT	VH	TEMP(H) DEG RANKINE	STATIC(H) PRES. RATIO	HAMMERSHOCK (H) FACE	HAMMERSHOCK (H) THROAT
0.0	.57	552.468	.7713	1.5640	1.5187
5000.0	.62	539.813	.7688	1.5760	1.5274
10000.0	.68	527.677	.7660	1.5869	1.5342
15000.0	.74	516.488	.7629	1.5966	1.5391
20000.0	.81	506.629	.7593	1.6049	1.5416
21250.0	.83	504.163	.7584	1.6069	1.5421
22500.0	.85	501.785	.7575	1.6088	1.5424
36250.0	.85	446.321	.7575	1.6447	1.5768
50000.0	.85	446.321	.7575	1.6447	1.5768

ALT	VL	TEMP(L) DEG RANKINE	STATIC(L) PRES. RATIO	HAMMERSHOCK (L) FACE	HAMMERSHOCK (L) THROAT
0.0	.60	556.014	.7700	1.5610	1.5143
5000.0	.65	543.142	.7675	1.5729	1.5227
10000.0	.71	531.158	.7647	1.5838	1.5294
15000.0	.77	520.160	.7616	1.5935	1.5341
20000.0	.84	510.476	.7580	1.6017	1.5364
21250.0	.85	507.615	.7573	1.6041	1.5374
22500.0	.87	504.801	.7565	1.6064	1.5384
36250.0	.87	449.004	.7565	1.6435	1.5739
50000.0	.87	449.004	.7565	1.6435	1.5739

	PRES(H) THROAT-PSIA	PRES(H) ENGINE-PSIA	PRES(L) THROAT-PSIA	PRES(L) ENGINE-PSIA	STATIC PRES THROAT
0.0	27.905	28.736	28.385	29.260	14.433
5000.0	24.277	25.050	24.730	25.545	12.465
10000.0	21.131	21.857	21.556	22.322	10.778
15000.0	18.410	19.098	18.811	19.539	9.338
20000.0	16.093	16.754	16.470	17.170	8.126
21250.0	15.550	16.204	15.878	16.566	7.821
22500.0	15.029	15.676	15.307	15.984	7.527
36250.0	8.237	8.592	8.396	8.768	4.036
50000.0	4.254	4.437	4.336	4.528	2.084

Figure 29. Sample output of inlet design pressure data.

SUBROUTINE FUSGEO

General Description

Deck name:	FUSGEO
Entry name:	FUSGEO
Called by:	DATAIN
Subroutines called:	None

This subroutine calculates fuselage depth, width, vertical centroid, shape parameters, perimeter, cross-section area, and contour curvature at the synthesis cuts. Length, longitudinal centroid, surface area, volume, and weight moment of inertia per pound of distributed weight are calculated for segments bounded by synthesis cuts.

Data input to this routine consist of depth, width, and perimeter or perimeter correction factor at 10 geometry definition stations. Perimeter code, KC, is used to define the operation required on the input data. If KC is 1, the perimeter is defined at the geometry cuts in the PI array. If KC is 2, the perimeter correction factor is defined in the PI array and the perimeter is calculated and stored in the PI array.

As many as 19 synthesis cut stations are also defined in the input data set. Depth, width, and perimeter at the synthesis cuts are obtained by interpolation of the geometry definition cut data. Based on the assumption of rounded rectangle shapes, flat and circular arc segments are calculated from the depth, width, and perimeter. Peripheral length, cross-section area, and nominal radius of curvature are then calculated for the upper, lower, and side sectors. If the corner radius is less than 2 inches, the radius of curvature is assumed to be infinite and zero is used to designate the flat panels.

Segment data are calculated for nose, tail, and intermediate segments using equations presented in the methods discussions. Should a synthesis segment be less than, or equal to, 2 inches in length, geometry at the aft end of the segment is used to calculate segment surface area and volume.

Arrays and Variables Used

DI	Fuselage depth at geometry cut stations, in.
EQU(145)	0.98 lower limit on shape adjustment factor
EQU(146)	1.02 upper limit on shape adjustment factor
KC	Perimeter code 1 = perimeter input in PI array 2 = perimeter correction factor input in PI array

NC	Number of shell synthesis cuts
PI	Perimeter, in., or perimeter correction factor at geometry cut stations
WI	Fuselage width at geometry cut stations, in.
XI	Longitudinal stations of 10 geometry cuts, in.
XO	Longitudinal stations of NC synthesis cuts, in.
ZI	Vertical stations of fuselage half-depth at cut stations, in.

Arrays and Variables Calculated

BL	Lower sector panel peripheral length at synthesis cut, in.
BS	Side sector panel peripheral length at synthesis cut, in.
BU	Upper sector panel peripheral length at synthesis cut, in.
DELX	Shell segment length, in.
DOO	Vertical flat length of shell exterior contour at synthesis cut, in.
PER	Shell perimeter at synthesis cut, in.
RCL	Lower sector panel radius of curvature at synthesis cut, in.
RCS	Side sector panel radius of curvature at synthesis cut, in.
RCU	Lower sector panel radius of curvature at synthesis cuts, in.
RO	Corner radius of shell exterior contour at synthesis cuts, in.
SF	Shell segment surface area, $in.^2$
STOT	Total fuselage surface area, $in.^2$
S3	Cross-section area at synthesis cuts, $in.^2$
TOT(19)	Maximum fuselage depth, in.
TOT(20)	Maximum fuselage width, in.
UIX	Unit roll inertia of fuselage and contents about segment centroid, lb-$in.^2$/lb
UIY	Unit pitch inertia of fuselage and contents about segment centroid, lb-$in.^2$/lb
UIZ	Unit yaw inertia of fuselage and contents about segment centroid, lb-$in.^2$/lb
VOL	Shell segment volume, $in.^3$
VOLT	Total fuselage volume, $in.^3$
WO	Horizontal flat length of shell exterior contour at synthesis cut, in.
XBAR	X-centroid of shell segment, in.
ZO	Z-coordinate of section centroid at synthesis cut, in.

Scratch Arrays and Variables

I	Scratch counter
J	Scratch counter
S	Intermediate calculations
S1	Fuselage depth at synthesis cuts, in.
S2	Fuselage width at synthesis cuts, in.

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

WARNING FROM FUSGEO IN DATA MANAGEMENT
SECTION XX IS RECTANGULAR, CORR. FACTOR IS Y.YYY

WARNING FROM FUSGEO IN DATA MANAGEMENT
SECTION XX IS ROUNDED RECT., CORR. FACTOR IS Y.YYY

The foregoing warning message appears when the program encounters some difficulty in fitting the shape based on input geometry. XX locates the synthesis cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. This message appears only when the actual adjustment up or down is greater than 2 percent. Should the scaling factor indicate a significant revision, input data should be examined for possible errors. Diamond-shaped fuselages cannot be fit properly by this routine; therefore, judgment adjustments might be required.

SUBROUTINE WHVGEO

General Description

Deck name:	WHVGEO
Entry name:	WHVGEO
Called by:	DATAIN
Subroutines called:	None

This subroutine calculates surface structure and load reference geometry data from input planform, definitions of the wing, horizontal, and vertical tail. For the purpose of load calculations, the relative position of each of the lifting surfaces is required. This information is provided in the input data stream as either the leading edge apex station or as the station at the 25-percent mean aerodynamic chord (MAC). If the surface is located in terms of MAC, the routine calculates the leading edge apex station.

Loads and subsequent sizing are calculated at 11 synthesis cuts which may either be defined in the input data set or calculated in this routine. The 11 synthesis cuts can be defined in terms of fractions of the exposed semispan or in terms of actual span stations. If the cuts are not input, Y-coordinates of 10 cuts are calculated, starting at the side of fuselage and extending outboard at 10-percent increments of the exposed semispan. An eleventh cut is taken at 97.5 percent of the exposed semispan.

For variable-sweep wing aircraft, a nominal wing position is specified in the input data set. Forward and aft sweep position data are obtained by sweeping the nominal wing planform about the specified pivot point.

Horizontal tail geometry may be defined in the input data set for either gross or exposed surface geometry. If exposed data are defined, gross planform geometry is calculated by projecting the exposed surface geometry inboard to the vehicle centerline.

Vertical tail geometry is defined in the input set for a theoretical root at the intersection with the fuselage. Load reference planform geometry is determined from the fuselage geometry and horizontal tail position. If the horizontal tail is mounted on the vertical tail or on the fuselage forebody, the intersection of the vertical tail 50-percent root chord station with the fuselage half-depth plane is used as the load reference root. If the horizontal tail is mounted on the fuselage in the proximity of the vertical tail, the horizontal tail reference plane defines the vertical tail reference root. Load reference geometry is then calculated by projecting the input structure reference geometry inboard to the load reference line.

Arrays and Variables Used

EQU(66)	Rule-of-thumb location of outboard wing synthesis cut, fraction of exposed span
EQU(67)	Rule-of-thumb location of outboard horizontal tail synthesis cut, fraction of exposed span
EQU(68)	Rule-of-thumb location of outboard vertical tail synthesis cut, fraction of exposed span
GDH	Horizontal tail input geometry data (refer to Table 42)
GDI(2)	Variable-sweep wing indicator 0 = fixed wing 1 = variable-sweep wing
GDI(4)	Horizontal tail indicator 0 = shear tie-slab tail 1 = shear and moment tie 2 = spindle mounted

GDI(8)	Horizontal tail location indicator 0 = fuselage mounted 1 = horizontal tail mounted on vertical tail
GDV	Vertical tail input geometry data (refer to Table 44)
GDW	Wing input geometry data (refer to Table 45)
XI	Longitudinal stations of 10 fuselage geometry cuts, in.
ZI	Vertical stations of fuselage half-depth at geometry cuts, in.

Arrays and Variables Calculated

DVH	Horizontal tail geometry (refer to Table 35)
DVV	Vertical tail geometry (refer to Table 36)
DVW	Wing geometry data (refer to Table 37)
DVWT(394)	Y-coordinate of elastic axis at wing synthesis cut 2 with wing fixed or in aft position, in.
DVWT(395)	X-coordinate of elastic axis at wing synthesis cut 2 with wing fixed or in aft position, in.
DVWT(396)	Y-coordinate of elastic axis at wing synthesis cut 2 with wing fixed or in forward position, in.
DVWT(397)	X-coordinate of elastic axis at wing synthesis cut 2 with wing fixed or in forward position, in.
DVWT(861) to DVWT(871)	Y-coordinate of wing synthesis cuts for input (reference) planform geometry, in.

Scratch Arrays and Variables

AR	Aspect ratio of wing
AREA	Wing area, ft^2
CDA	Cosine of incremental sweep angle
DANGLE	Incremental sweep angle from nominal position, radians
ROOTC	Root chord, in.
S	Intermediate calculations (refer to Table 55)
SDA	Sine of incremental sweep angle
SPAN	Wing span, ft
SSPAN	Wing semispan, in.
TANEA	Sweep angle of elastic axis, deg
TANLE	Sweep angle of leading edge, deg
TAPER	Wing taper ratio
VAR	X-coordinate of elastic axis at vehicle centerline, in.
VAR1	Tangent of sweep angle of elastic axis
X	X-coordinate of planform geometry points, in.

TABLE 55. S-ARRAY VARIABLES IN SUBROUTINE WHVGEO

Loc	Engrg Symbol	Description
1	$\tan \Lambda_{EA}$	Tangent of wing reference axis sweep angle (input geometry)
2		Intermediate calculation
3	$\tan \Lambda_{LE}$	Tangent of wing leading edge sweep angle (input geometry)
4	$\tan \Lambda_{TE}$	Tangent of wing trailing edge sweep angle (input geometry)
5	$\tan \Lambda_{EA}$	Tangent of wing elastic axis sweep angle (input geometry)
6	$\tan \Lambda_{c/2}$	Tangent of wing 50-percent chord line sweep angle (input geometry)
7	MAC	Wing mean aerodynamic chord (input geometry), in.
8		Incremental segment length, 10 percent of exposed wing semispan, in.
9		Not used
10		Not used
11	C_R	Wing root chord (input geometry), in.
12	C_T	Wing tip chord (input geometry), in.
13	b	Wing span, in.
14	Λ_{LE}	Wing leading edge sweep angle (input geometry), deg
15	Λ_{TE}	Wing trailing edge sweep angle (input geometry), deg
16	Λ_{EA}	Wing elastic axis sweep angle (input geometry), deg
17	$\Lambda_{c/2}$	Wing 50-percent chord line sweep angle (input geometry), deg
18	X_{LE}	Longitudinal station of wing leading edge apex (input geometry), in.
19	$(X/C)_{EA}$	Wing structural elastic axis location in terms of fraction of total chord (input geometry)
20 • 30	Y_1 Y_{11}	Y-coordinate at wing synthesis cut 1 (input geometry), in. To Y-coordinate at wing synthesis cut 11 (input geometry), in.

TABLE 55. S-ARRAY VARIABLES IN SUBROUTINE WHVGEO (CONT)

Loc	Engrg Symbol	Description
31		Not used
.		
34		Not used
35	$\tan \Lambda_{c/4}$	Tangent of wing quarter-chord line sweep angle (input geometry)
36		Not used
.		
60		Not used
61	$\tan \Lambda_{REF}$	Tangent of vertical tail reference axis sweep angle
62		Intermediate calculation
63	$\tan \Lambda_{LE}$	Tangent of vertical tail leading edge sweep angle
64	$\tan \Lambda_{TE}$	Tangent of vertical tail trailing edge sweep angle
65	$\tan \Lambda_{EA}$	Tangent of vertical tail elastic axis sweep angle
66	C_R	Vertical tail root chord (input geometry), in.
67	C_T	Vertical tail tip chord, in.
68	b	Span of input geometry vertical tail, in.
69	MAC	Mean aerodynamic chord of input geometry vertical tail, in.
70	X_{LE}	Longitudinal station of vertical tail leading edge at input geometry root, in.
71		Intermediate calculations
72		Z-coordinate of vertical tail load reference root, in.
73		Distance from vertical tail root to horizontal tail reference plane if horizontal-mounted on vertical tail, in.
74	$\tan \Lambda_{c/4}$	Tangent of vertical tail quarter-chord line sweep angle
75		Not used
.		
90		Not used
91	$\tan \Lambda_{REF}$	Tangent of horizontal tail reference axis sweep angle

TABLE 55. S-ARRAY VARIABLES IN SUBROUTINE WHVGEO (CONCL)

Loc	Engrg Symbol	Description
92		Intermediate calculation
93	$\tan \Lambda_{LE}$	Tangent of horizontal tail leading edge sweep angle
94	$\tan \Lambda_{EA}$	Tangent of horizontal tail elastic axis sweep angle
95	C_R	Horizontal tail root chord (input geometry), in.
96	C_T	Horizontal tail tip chord, in.
97	b	Horizontal tail span (input geometry), in.
98	MAC	Horizontal tail mean aerodynamic chord (input geometry), in.
99	X_{LE}	Longitudinal station of horizontal tail leading edge (input geometry), in.
100		Incremental segment length, 10 percent of exposed horizontal tail exposed semispan, in.
101	$\tan \Lambda_{C/4}$	Tangent of horizontal tail quarter-chord line sweep angle
102		Intermediate calculation
103		Intermediate calculation
104		Intermediate calculation

XOC	Structural elastic axis location in terms of fraction of total chord
XPNT	Intermediate calculation
X1P	X-coordinate of wing leading edge apex, in.
X2P	X-coordinate of wing trailing edge apex, in.
X3P	X-coordinate of wing leading edge at tip, in.
X4P	X-coordinate of wing trailing edge at tip, in.
Y	Y-coordinate of planform geometry points, in.
YPNT	Intermediate calculation

Labeled Common Arrays

XMISC(12)	Aspect ratio of wing fixed or aft
XMISC(13)	Quarter-chord sweep of wing fixed or aft, deg
XMISC(14)	Taper ratio of wing fixed or aft
XMISC(16)	Aspect ratio of horizontal tail
XMISC(17)	Quarter-chord sweep of horizontal tail, deg
XMISC(18)	Taper ratio of horizontal tail
XMISC(20)	Aspect ratio of vertical tail
XMISC(21)	Quarter-chord sweep of vertical tail, deg
XMISC(22)	Taper ratio of vertical tail
XMISC(25)	Aspect ratio of wing in forward position
XMISC(26)	Quarter-chord sweep of wing in forward position, deg
XMISC(27)	Taper ratio of wing in forward position

Mass Storage File Records

None

Error Messages

None

SUBROUTINE DUCGEO

General Description

Deck name:	DUCGEO
Entry name:	DUCGEO
Called by:	DATAIN
Subroutines called:	None

This subroutine calculates shape parameters at the duct cuts and length, longitudinal centroid, and surface area for segments bounded by cuts. The surface area is calculated for the total number of ducts in the fuselage or, for podded engines, the total number of ducts in a nacelle.

Data input to this routine consists of depth, width, lateral centroid, and either perimeter or perimeter correction factor at as many as 10 duct stations. The first cut describes geometry at the leading edge, and the last cut describes geometry at the engine face. Perimeter code, KCD, is used to designate whether the perimeter or perimeter correction factor is defined. If KCD is 1, the perimeter is input at the cuts. If KCD is 2, the perimeter correction factor is input data, and the perimeter is calculated and substituted for the correction factors.

Input geometry describes a single duct. If the lateral centroid at a cut is a positive value, two ducts are indicated and the surface area is calculated for the two ducts. Should the lateral centroid at a cut be zero followed by a cut where the lateral centroid is a positive value, this indicates division of a single duct into two ducts. Conversely, two ducts could join to become a single duct. In either case, geometry at the aft cut is used to calculate the surface area for the segment in which the transition occurs.

In most instances, the duct leading edge is a complete section. However, should there be a one-dimensional leading edge, the single dimension is described in the input data set; the perimeter or perimeter correction factor is not input for this station. The second cut would then describe the first complete duct section. The surface area for this leading edge segment is then calculated from the geometry at the two bounding cuts. The segment longitudinal centroid is assumed to be two-thirds of the distance aft of the leading edge. The longitudinal centroid for all other segments or for a continuous leading edge segment is assumed to be midway between bounding cuts.

Arrays and Variables Used

DATD(11)-DATD(20)	Duct cut stations relative to inlet leading edge, in. (DATD(11) = 0.0)
DATD(21)-DATD(30)	Duct lateral centroid at cuts, in.
DATD(41)-DATD(50)	Duct depth at cuts, in.
DATD(51)-DATD(60)	Duct width at cuts, in.
DATD(61)-DATD(70)	Duct perimeter, in., or perimeter correction factor at cuts
EQU(145)	0.98, lower limit of shape adjustment for warning message
EQU(146)	1.02, upper limit of shape adjustment for warning message

KCD	Perimeter code 1 = perimeter input 2 = perimeter correction factor input
NCD	Number of input cuts (10 maximum)

Arrays and Variables Calculated

BLD	Lower sector panel peripheral length at cuts, in.
BSD	Side sector panel peripheral length at cuts, in.
BUD	Upper sector panel peripheral length at cuts, in.
DLXD	Duct segment length between cuts, in.
DOD	Vertical flat length of duct contour at cuts, in.
IGD	Duct leading-edge-type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
ROD	Corner radius of duct contour at cuts, in.
SFD	Duct segment, surface area, $in.^2$
WOD	Horizontal flat length of duct contour at cuts, in.
XBD	X-centroid of duct segments, in.

Scratch Arrays and Variables

I	Scratch counter
J	Scratch counter
S	Intermediate calculations

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

WARNING FROM DUCGEO IN DATA MANAGEMENT
DUCT LIP GEOMETRY ERROR

The foregoing message is printed when a one-dimensional leading edge is indicated by zero in input location DATD(61) and neither depth or width are defined for the leading edge station. The surface area calculated for the leading edge segment represents two triangular sides and a triangular top.

WARNING MESSAGE FROM DUCGEO IN DATA MANAGEMENT
SECTION XX IS RECT. OR ROUNDED RECT. CORRECTION IS Y.YYY

The foregoing warning message appears when the program encounters difficulty in fitting the shape, based on input geometry. XX locates the cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. This message appears only when the correction up or down is greater than 2 percent. Should the scaling factor indicate a significant revision, the input data should be examined for possible errors.

SUBROUTINE NACGEO

General Description

Deck name:	NACGEO
Entry name:	NACGEO
Called by:	DATAIN
Subroutines called:	None

This subroutine calculates shape parameters at the nacelle cuts and length, longitudinal centroid, surface area, and weight moment of inertia per pound of distributed weight for segments bounded by cuts.

Data input to this routine consist of depth, width, and either perimeter or perimeter correction factor at as many as 10 nacelle stations. The first cut describes geometry at the inlet leading edge, and the last cut describes geometry at the last full nacelle section. Perimeter code, KCN, is used to designate whether the perimeter or perimeter correction factor is defined. If KCN is 1, the perimeter is input at the cuts. If KCN is 2, the perimeter correction factor is input data, and the perimeter is calculated and substituted for the correction factors.

For one-dimensional leading edges, the single dimension is described at the first cut; the perimeter or perimeter correction factor is not input for this station. The second cut describes the first complete nacelle section. The surface area for this segment is not calculated, since it is already accounted for in the duct calculations. Segment centroid is assumed to be two-thirds of the distance aft of the leading edge. Longitudinal centroid for all other segments or for a continuous leading edge segment is assumed to be midway between cuts.

Arrays and Variables Used

DATN(11)-DATN(20)	Nacelle cut stations relative to inlet leading edge, in. (DATN(11) = 0.0)
DATN(41)-DATN(50)	Nacelle depth at cuts, in.
DATN(51)-DATN(60)	Nacelle width at cuts, in.
DATN(61)-DATN(70)	Nacelle perimeter, in., or perimeter correction factor at cuts
EQU(145)	0.98, lower limit of shape adjustment for warning message
EQU(146)	1.02, upper limit of shape adjustment for warning message
KCN	Perimeter code 1 = perimeter input 2 = perimeter correction factor input
NCN	Number of input cuts (10 maximum)

Arrays and Variables Calculated

BLN	Lower sector panel peripheral length at cuts, in.
BSN	Side sector panel peripheral length at cuts, in.
BUN	Upper sector panel peripheral length at cuts, in.
DLXN	Nacelle segment length between cuts, in.
DON	Vertical flat length of nacelle contour at cuts, in.
IGN	Nacelle leading-edge-type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
RCLN	Lower sector panel radius of curvature at cuts, in.
RCSN	Side sector panel radius of curvature at cuts, in.
RCUN	Upper sector panel radius of curvature at cuts, in.
RON	Corner radius of nacelle contour at cuts, in.
SFN	Nacelle segment surface area, in.^{2}
UIXN	Unit roll inertia of nacelle and contents within segment about segment centroid, lb-in.^{2}/lb
UIYN	Unit pitch inertia of nacelle and contents within segment about segment centroid, lb-in.^{2}/lb
UIZN	Unit yaw inertia of nacelle and contents within segment about segment centroid, lb-in.^{2}/lb
WON	Horizontal flat length of nacelle contour at cuts, in.
XBN	X-centroid of nacelle segments, in.

Scratch Arrays and Variables

I Scratch counter
J Scratch counter
S Intermediate calculations

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

WARNING FROM NACGEO IN DATA MANAGEMENT
NACELLE LIP GEOMETRY ERROR

The foregoing message is printed when a one-dimensional leading edge is indicated by zero in input location DATN(61) and neither depth or width are defined for the leading edge station. Unit inertias are calculated for this segment, assuming a horizontal lip-type configuration.

WARNING FROM DUCGEO IN DATA MANAGEMENT
SECTION XX IS RECT. OR ROUNDED RECT. CORR. FACTOR IS Y.YYY

The foregoing warning message appears when the program encounters some difficulty in fitting the shape, based on input geometry. XX locates the cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. This message appears only when the correction up or down is greater than 2 percent. Should the scaling factor indicate a significant revision, input data should be examined for possible errors.

SUBROUTINE NOSGEO

General Description

Deck name:	NOSGEO
Entry name:	NOSGEO
Called by:	DATAIN
Subroutines called:	None

This routine determines vehicle nose geometry parameters. The aft end of the nose is defined as the smallest of the following:

1. The apex of the wing or horizontal tail, whichever is smaller

2. The first fuselage station, going aft, where cross-sectional area is constant or decreasing

3. The fuselage station where segment length is less than, or equal to, 2.0 and cross-sectional area increases by 5 percent or more.

Once the aft end of the nose is determined, the radius at that point and the nose volume are determined.

All variables referenced in this routine are in blank common.

Arrays and Variables Used

DELX	Array of lengths of fuselage segments, in.
DVH(4)	Fuselage station of apex of horizontal tail
DVW(47)	Fuselage station of apex of wing
NC	Number of fuselage synthesis cuts input
S3	Array of fuselage cross-sectional areas, $in.^2$
VOL	Array of fuselage volumes, $in.^3$
XI	Array of fuselage geometry cuts, in.
XO	Array of fuselage synthesis cuts, in.

Arrays and Variables Calculated

BC(33)	X_O Distance from reference X to body nose, in.
BC(34)	L_N Length of nose, in.
BC(35)	V_N Volume of nose, $in.^3$
BC(36)	R_N Radius of base of nose, in.

Scratch Arrays and Variables

N	Scratch index and counter
S(1)	Smaller of wing apex or horizontal tail apex
S(2)	Fuselage station where cross section first is constant or decreasing, or XO(NC+1)
S(3)	Fuselage station where ducts start or XI(10)
S(4)	Smallest of three values: S(1), S(2), or S(3)
S(5)	Volume of nose
S(6)	Radius of aft end of nose

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE QUIKIE

General Description

Deck name:	QUIKIE
Entry name:	QUIKIE
Called by:	DATAIN
Subroutines called:	None

This subroutine evaluates the input detail weight data to determine the vehicle weight and center of gravity (CG). Should all structure component weights be defined in the input data set, these detail weight and CG data are used to determine the vehicle weight and balance. A message is printed when all structure weight data are defined in the input set, as shown in the following:

*** ALL DETAIL WEIGHTS AND C.G.S WERE INPUT ***

Should any or all of the following structure component weights be omitted from the input set, initial weight and CG approximations are made by using statistical regression equations and rule-of-thumb methods. These equations and methods are discussed in Section II of this report.

Structure

Wing
Horizontal tail
Vertical tail
Fuselage
Main landing gear
Nose landing gear
Engine section and nacelles
Air induction system structure

Proportionate corrections are made to the estimated weight and CG of only those items estimated by this routine such that the input definition of vehicle basic flight design weight (BFDW) and CG are maintained. Initial and corrected weight and CG is printed as shown in Figure 30.

This routine also distributes engine section and nacelle weights between inboard and outboard engine packages. This distribution is performed in this routine since, on vehicles with four nacelles, inboard pylons may differ from the outboard pylons. There is no differentiation of this fact other than in the detail calculations of engine section and nacelle weights.

Arrays and Variables Used

DATD Input duct geometry data (refer to Table 28)
DATR Input two-dimensional variable geometry ramp data (refer to Table 31)
DATS Input engine related data (refer to Table 32)
DSP Inlet pressure and vehicle flight profile data (refer to Table 33)
DVH Calculated horizontal tail geometry data (refer to Table 35)
DVV Calculated vertical tail geometry data (refer to Table 36)
DVW Calculated wing geometry data (refer to Table 37)
EQU Equation constants (refer to Table 39)
GDD Vehicle design data (refer to Table 41)
GDH Input horizontal geometry data (refer to Table 42)
GDI Vehicle design indicators (refer to Table 43)
GDV Input vertical tail geometry data (refer to Table 44)
GDW Input wing geometry data (refer to Table 45)
GDWT Input detail weight data (refer to Table 46)
IGD Inlet lip type
  0 = continuous section
  1 = vertical lip
  2 = horizontal lip
IGN Nacelle leading edge type
  0 = continuous section
  1 = vertical lip
  2 = horizontal lip
ITP Engine package type
  0 = fuselage buried engines
  2 or 4 = number of nacelles
IVG Inlet type
  1 = fixed duct
  2 = fixed spike
  3 = two-dimensional horizontal ramps
  4 = two-dimensional vertical ramps
  5 = translating spike
  6 = translating and expanding spike

STRUCTURE WEIGHT DATA FROM QUIKIE TO DATA MANAGEMENT ** QUIKIE **

	INITIAL ESTIMATE WEIGHT	INITIAL ESTIMATE HORIZ ARM	CHARACTERISTIC LENGTH	CORRECTED ESTIMATE WEIGHT	CORRECTED ESTIMATE HORIZ ARM
WING	27155.7	972.3	238.0	31996.7	981.6
HORIZONTAL TAIL	3111.9	1842.0	123.2	3666.6	1846.8
VERTICAL TAIL	1842.6	1741.1	224.0	2171.0	1749.9
FUSELAGE	26418.3	992.4	1587.5	31127.9	1054.8
MAIN GEAR	6938.5	920.0	61.7	8175.4	922.4
NOSE GEAR	723.1	354.7	41.5	852.0	356.4
ENGINE SECTION	5212.2	788.3	187.0	6141.4	795.6
AIR IND. SYSTEM	706.9	698.5	12.0	832.9	699.0

Figure 30. Sample output of initial estimated structure weight and balance.

NCD Number of duct cuts
NCN Number of nacelle cuts
SFD Duct segment surface area, $in.^2$
SFN Nacelle segment surface area, $in.^2$
TOT Fuselage geometry summary (refer to Table 49)
XBD X-centroid of duct segments referenced to inlet lip, in.
XBN X-centroid of nacelle segments referenced to inlet lip, in.
XI X-station of fuselage geometry cuts, in.

Arrays and Variables Calculated

DVWT Detail weight data (refer to Table 38)

Scratch Arrays and Variables

I Scratch counter
J Scratch counter
K Scratch counter
N Scratch counter
S Intermediate calculations (refer to Table 56)

Labeled Common Arrays

IP(44) Print/no-print indicator
0 = print intermediate calculation variables in S-array (see Figure 31)
1 = no print

Mass Storage File Records

None

Error Messages

None

TABLE 56. S-ARRAY VARIABLES IN SUBROUTINE QUIKIE

Loc	Description
1	Summation of weights for known items at BFDW, lb
2	Summation of moments for known items at BFDW (wing in nominal position), in.-lb
3	Summation of initial weights for estimated items, lb
4	Summation of adjusted weights for estimated items, lb
5	Summation of moments for estimated items using adjusted weights and initial CG estimates, in.-lb
6	Summation of moments for estimated items, adjusted weights times characteristic lengths, in.-lb
7	Not used
•	
10	Not used
11	Weight adjusted factor
12	Required vehicle moments, in.-lb
13	Moment discrepancy between required and initial calculated moments, in.-lb
14	CG adjustment factor
15	Not used
•	
19	Not used
20	Maximum positive maneuver load factor
21	Wing weight equation gross weight parameter
22	Wing weight equation dynamic pressure parameter
23	Wing weight equation planform area parameter
24	Wing weight equation aspect ratio parameter
25	Wing weight equation thickness ratio parameter
26	Wing weight equation taper ratio parameter
27	Wing weight equation landing gear factor
28	Wing weight equation pivot factor
29	Wing taper ratio, limited to no less than 0.001

TABLE 56. S-ARRAY VARIABLES IN SUBROUTINE QUIKIE (CONT)

Loc	Description
30	Horizontal tail, vertical tail, and fuselage weight equation intermediate calculations
•	
37	
38	Not used
•	
40	Not used
41	Initial duct weight estimate per nacelle
42	Moment of duct relative to inlet leading edge, in.-lb
43	Initial nacelle weight estimate per nacelle, lb
44	Moment of nacelle relative to inlet leading edge, in.-lb
45	Initial estimate of engine section and nacelle weight per vehicle, lb
46	Summation of moments for engine section and nacelle weight, in.-lb
47	Initial estimate of air induction system structure per vehicle, lb
48	Summation of moments for air induction system structure
49	Not used
50	Not used
51	Intermediate calculations
•	
55	Intermediate calculations
56	Not used
•	
58	Not used
59	Intermediate calculations
60	Intermediate calculations
61	Initial weight estimate of ramps or spikes per vehicle, lb
62	Calculated weight for ducts per nacelle or per vehicle for fuselage-buried engines, lb
63	Calculated weight for nacelle per nacelle, lb
64	Calculated weight for each inboard pylon, lb
65	Calculated weight for each outboard pylon, lb
66	Calculated weight for engine mounts per vehicle, lb
67	Not used
•	
70	Not used

TABLE 56. S-ARRAY VARIABLES TO SUBROUTINE QUIKIE (CONT)

Loc	Description
71	CG of ramps or spikes relative to inlet leading edge, in.
72	CG of duct relative to inlet leading edge, in.
73	CG of nacelle relative to inlet leading edge, in.
74	CG of inboard pylon relative to inlet leading edge, in.
75	CG of outboard pylon relative to inlet leading edge, in.
76	CG of engine mounts relative to inlet leading edge, in.
77	Not used
•	
80	Not used
81	Calculated weight of duct segment 1 per nacelle, lb
•	To
90	Calculated weight of duct segment 10 per nacelle, lb
91	Calculated weight of nacelle segment 1 per nacelle, lb
•	To
100	Calculated weight of nacelle segment 10 per nacelle , lb
101	Initial weight estimate for wing, lb
102	Initial weight estimate for horizontal tail, lb
103	Initial weight estimate for vertical tail, lb
104	Initial weight estimate for fuselage, lb
105	Initial weight estimate for main landing gear, lb
106	Initial weight estimate for nose landing gear, lb
107	Initial weight estimate for engine section and nacelles, lb
108	Initial weight estimate for air induction system structure, lb
109	Not used
110	Not used
111	Initial estimate for wing CG, in.
112	Initial estimate for horizontal tail CG, in.
113	Initial estimate for vertical tail CG, in.
114	Initial estimate for fuselage CG, in.

TABLE 56. S-ARRAY VARIABLES IN SUBROUTINE QUIKIE (CONT)

Loc	Description
115	Initial estimate for main landing gear CG, in.
116	Initial estimate for nose landing gear CG, in.
117	Initial estimate for engine section and nacelles CG, in.
118	Initial estimate for air induction system structure CG, in.
119	Not used
120	Not used
121	Characteristic length for wing, MAC, in.
122	Characteristic length for horizontal tail, MAC, in.
123	Characteristic length for vertical tail, MAC, in.
124	Characteristic length for fuselage, fuselage length, in.
125	Characteristic length for main landing gear, strut length, in.
126	Characteristic length for nose landing gear, strut length, in.
127	Characteristic length for engine section and nacelles, engine length, in.
128	Characteristic length for air induction system structure, inlet length, in.
129	Not used
130	Not used
131	Adjusted weight estimate for wing, lb
132	Adjusted weight estimate for horizontal tail, lb
133	Adjusted weight estimate for vertical tail, lb
134	Adjusted weight estimate for fuselage, lb
135	Adjusted weight estimate for main landing gear, lb
136	Adjusted weight estimate for nose landing gear, lb
137	Adjusted weight estimate for engine section and nacelles, lb
138	Adjusted weight estimate for air induction system structure, lb
139	Not used
140	Not used

TABLE 56. S-ARRAY VARIABLES IN SUBROUTINE QUIKIE (CONCL)

Loc	Description
141	Adjusted estimate for wing CG, in.
142	Adjusted estimate for horizontal tail CG, in.
143	Adjusted estimate for vertical tial CG, in.
144	Adjusted estimate for fuselage CG, in.
145	Adjusted estimate for main landing gear CG, in.
146	Adjusted estimate for nose landing gear CG, in.
147	Adjusted estimate for engine section and nacelles CG, in.
148	Adjusted estimate for air induction system structure CG, in.
149	Not used
150	Not used

		S-REGION			** QUIKIE - TP(44) **
1	231135.9924	2063698642.3492	72109.0869	84964.0076	85781995.2371
6	59666202.7856	0.0000	0.0000	0.0000	0.0000
11	1.1783	294494565.0000	2343817.4137	.0393	0.0000
16	0.0000	0.0000	0.0000	0.0000	2.5000
21	451.1022	2.2907	432.4823	4.1067	2.3586
26	.9657	1.0000	1.0000	.4175	2.5000
31	14288.1429	11.0842	1.2244	1.1563	4.5415
36	1.4187	.6089	0.0000	0.0000	0.0000
41	33.3256	202.7125	662.7029	49951.7286	5212.1968
46	4108753.8896	706.8379	493779.2180	0.0000	0.0000
51	.5000	-44.5000	17.4774	21.0596	2.5516
56	0.0000	0.0000	0.0000	1727.4606	777.6037
61	675.8508	39.2666	780.8434	671.6142	671.6142
66	331.5477	0.0000	0.0000	0.0000	0.0000
71	6.4714	6.5542	82.7215	126.3396	126.3396
76	107.5458	0.0000	0.0000	0.0000	0.0000
81	19.0915	20.1751	0.0000	0.0000	0.0000
86	0.0000	0.0000	0.0000	0.0000	0.0000
91	41.4507	84.8294	84.8294	253.5242	83.6654
96	82.5801	79.3669	70.3072	0.0000	0.0000
101	27155.6749	3111.8836	1842.5647	26418.2755	6938.5103
106	723.0772	5212.1968	706.8079	0.0000	0.0000
111	972.2837	1842.0042	1741.1261	992.4000	920.0000
116	354.7500	788.2960	698.5156	0.0000	0.0000
121	237.9687	123.2409	224.0326	1587.5000	51.7000
126	41.5000	187.0000	12.0000	0.0000	0.0000
131	31996.7324	3666.6409	2171.0398	31127.8764	8175.4425
136	851.9806	6141.3781	832.9170	0.0000	0.0000
141	951.6317	1846.8453	1749.9266	1054.7604	922.4237
146	356.3802	795.6418	698.9970	0.0000	0.0000

Figure 31. Sample output of S-array variables from subroutine QUIKIE.

SUBROUTINE WEIDST

General Description

Deck name:	WEIDST
Entry name:	WEIDST
Called by:	DATAIN
Subroutines called:	None

This subroutine performs the first-level distribution by taking the operational weight empty data and distributing the weight to the fuselage, wing, horizontal tail, vertical tail, inboard nacelles or engine package, and outboard nacelles. Methods used to distribute the different weight items are discussed in Section II of this report.

Arrays and Variables Used

DATS	Input engine related data (refer to Table 32)
DVWT	Detail weight data (refer to Table 38)
EQU	Distribution constants (refer to Table 39)
GDI	Vehicle design indicators (refer to Table 43)
GDWT	Input detail weight data (refer to Table 46)

Arrays and Variables Calculated

DVWT	Detail weight data (refer to Table 38)

Scratch Arrays and Variables

I	Scratch counter
II	Engine package indicator 1 = fuselage-buried engines or two nacelles 2 = four nacelles
J	Scratch counter
S(51) to S(58)	Intermediate calculations and distribution factors

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE PRTOWE

General Description

Deck name:	PRTOWE
Entry name:	PRTOWE
Called by:	DATAIN
Subroutines called:	None

This routine sets up and writes the operational weight empty and the expandable useful load tables (see Figures 32 and 33). The routine is not entered unless these printouts are requested.

To form the operational weight empty table, an array of six columns and 40 rows is set up in the scratch area. This sparse array makes the breakdown of items to the major components readily perceptable.

The major items of expendable useful load are shown for three gross weights: takeoff, flight design, and landing.

Arrays and Variables Used

Selected items from arrays DVWT and GDWT are used in the two printouts; these items are defined in Tables 57 and 58.

AI, DVWT(261)	Array of weights for inboard nacelle or fuselage-mounted engine package and contents
AO, DVWT(301)	Array of weights for outboard nacelle and contents
F, DVWT(101)	Array of weights for fuselage and contents
GDWT	Array of input weights for various items
H, DVWT(221)	Array of weights for horizontal tail and contents
V, DVWT(241)	Array of weights for vertical tail and contents
W, DVWT(181)	Array of weights for wing and contents

DATA MANAGEMENT *** OPERATIONAL WEIGHT EMPTY *** ** PPTOWE - IP(66) **
TOTAL AND MAJOR COMPONANT BREAK DOWN

	TOTAL WT.	ARM	FUSELAGE	WING	HORIZONTAL	VERTICAL	TB NACELLE	OR NACELLE
WING	31996.7	991.6	0.0	31996.7	0.0	0.0	0.0	0.0
HORIZONTAL	3666.6	1846.8	0.0	0.0	3666.6	0.0	0.0	0.0
VERTICAL	2171.0	1749.9	0.0	0.0	0.0	2171.0	0.0	0.0
BODY	31127.9	1054.8	31127.9	0.0	0.0	0.0	0.0	0.0
MAIN GEAR	8175.4	922.4	8175.4	0.0	0.0	0.0	0.0	0.0
NOSE GEAR	852.0	356.4	852.0	0.0	0.0	0.0	0.0	0.0
SURF. CONTROL	3714.0	1121.8	700.1	1724.1	888.0	401.9	0.0	0.0
ENG. SECTION	6141.4	795.6	0.0	0.0	0.0	0.0	3070.7	3070.7
OTHER STRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENGINES	18759.0	774.1	0.0	0.0	0.0	0.0	9379.5	9379.5
ACCESSORY G BOX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AIS STRUCTURE	832.9	699.0	0.0	0.0	0.0	0.0	416.5	416.5
AIS ACT AND MEC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXHAUST	3577.0	845.7	0.0	0.0	0.0	0.0	1788.5	1788.5
COOL. AND DRNS.	144.0	803.9	0.0	0.0	0.0	0.0	72.0	72.0
LUBE SYSTEM	212.0	840.8	0.0	0.0	0.0	0.0	106.0	106.0
FUEL SYSTEM	1380.0	953.4	0.0	1380.0	0.0	0.0	0.0	0.0
ENGINE CONTROLS	236.0	666.2	236.0	0.0	0.0	0.0	0.0	0.0
STARTING SYS.	320.0	768.3	0.0	0.0	0.0	0.0	160.0	160.0
A P U	554.0	844.7	0.0	0.0	0.0	0.0	277.0	277.0
INSTRUMENTS	1122.0	545.0	897.6	112.2	0.0	0.0	56.1	56.1
HYDRAULICS	1489.0	881.9	997.6	0.0	0.0	0.0	245.7	245.7
ELECTRICAL	2650.0	657.5	1987.5	0.0	0.0	0.0	331.3	331.3
ELECTRONIC	2347.0	502.4	2347.0	0.0	0.0	0.0	0.0	0.0
ARMAMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FURNISHINGS	3320.0	506.8	3320.0	0.0	0.0	0.0	0.0	0.0
AIR CONDITION.	2648.0	809.9	2118.4	0.0	0.0	0.0	264.8	264.8
PHOTO.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AUX. GEAR	95.0	1228.0	95.0	0.0	0.0	0.0	0.0	0.0
OTHER EQUIPMENT	113.0	300.0	113.0	0.0	0.0	0.0	0.0	0.0
CREW	860.0	351.3	860.0	0.0	0.0	0.0	0.0	0.0
TRAP. FUEL	2164.0	1001.9	0.0	2164.0	0.0	0.0	0.0	0.0
OIL	416.0	753.6	0.0	0.0	0.0	0.0	208.0	208.0
LN2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MISCELLANEOUS	236.0	853.0	236.0	0.0	0.0	0.0	0.0	0.0
GUNS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W. PYLONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W. EXT. TANKS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F. PYLONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F. EXT. TANKS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 32. Sample output of operational weight empty and first-level weight distribution.

** PRTOWE -,IP(46) **

DATA MANAGEMENT --- EXPENDABLE USEFUL LOAD

	------- CAPACITY -------		TOGW	FDGW	LDGW
	WEIGHT	ARM			
PASSENGERS OR PAYLOAD	70000.00	887.00	70000.00	70000.00	70000.00
WING PAYLOAD	0.00	0.00	0.00	0.03	0.00
AMMUNITION	0.00	0.00	0.00	0.00	0.00
WING FUEL TANK 1	67640.00	858.00	67640.00	65739.99	28090.00
WING FUEL TANK 2	49040.00	1047.34	49040.00	49040.00	28090.00
FUSELAGE FUEL TANK 1	0.00	0.00	0.00	0.00	0.00
FUSELAGE FUEL TANK 2	0.00	0.00	0.00	0.00	0.00
FUSELAGE FUEL TANK 3	0.00	0.00	0.00	0.00	0.00
FUSELAGE FUEL TANK 4	0.00	0.00	0.00	0.00	0.00
FUSELAGE FUEL TANK 5	0.00	0.00	0.00	0.00	0.00

Figure 33. Sample output of expendable useful load tables.

TABLE 57. DVWT LOCATIONS FOR ITEMS PRINTED IN OPERATIONAL WEIGHT EMPTY TABLE

Operational Weight Empty Items	Total Weight	Arm	T (I, J) Array Location I = 1 Fuselage	2 Wing	3 Horizontal Tail	4 Vertical Tail	5 Inboard Nacelle	6 Outboard Nacelle	J
Wing	1	51		181					1
Horizontal tail	2	52			221				2
Vertical tail	3	53				241			3
Body	4	54	101						4
Main gear	5	55	102	182					5
Nose gear	6	56	103						6
surface controls	7	57	*	183	222	242			7
Engine section	8	58					261	301	8
Other structure	9	59	106						9
Engines	10	60					262	302	10
Accessories & gearboxes	11	61					263	303	11
AIS structure	12	62					264	304	12
AIS actuators & mechanism	13	63					265	305	13
Exhaust system	14	64					266	306	14
Cooling & drain systems	15	65					267	307	15
Lubrication systems	16	66					268	308	16
Fuel system	17	67	107	184					17
Engine controls	18	68	108						18
Starting system	19	69					269	309	19
Auxiliary power units	20	70	109				270	310	20
Instruments	21	71	110	185			271	311	21
Hydraulic systems	22	72	111				272	312	22
Electrical systems	23	73	112				273	313	23
Electronic systems	24	74	113						24
Armament	25	75	114						25
Furnishings	26	76	115						26
Air conditioning	27	77	116				274	314	27
Photographic equipment	28	78	117						28
Auxiliary gear	29	79	118						29
Other equipment	30	80	119						30
Crew	31	81	120						31
Trapped fuel	32	82	121	186					32
Oil	33	83					275	315	33
Liquid nitrogen	34	84	122						34
Miscellaneous	35	85	123						35
Guns	36	86	124						36
Wing-mounted pylons	37	87		187					37
Wing external tanks	38	88		188					38
Fuselage-mounted pylons	39	89	125						39
Fuselage external tanks	40	90	126						40

* = 104 + 105

TABLE 58. LOCATIONS FOR ITEMS PRINTED IN EXPENDABLE USEFUL LOAD TABLE

	GDWT		DVWT		
	Capacity		At Takeoff Weight	At Flight Design Weight	At Landing Weight
	Weight	Arm			
Passengers or payload	81	91	841	41	851
Wing payload	82	92	842	42	852
Ammunition	83	93	843	43	853
Wing fuel tank No. 1	84	94	844	44	854
Wing fuel tank No. 2	85	95	845	45	855
Fuselage fuel tank No. 1	86	96	846	46	856
Fuselage fuel tank No. 2	87	97	847	47	857
Fuselage fuel tank No. 3	88	98	848	48	858
Fuselage fuel tank No. 4	89	99	849	49	859
Fuselage fuel tank No. 5	90	100	850	50	860

Arrays and Variables Calculated

None

Scratch Arrays and Variables

N Scratch counter
S General scratch array; use 1 through 240
T Double-subscripted array equivalent to S, used for operational weight empty breakdown

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE WNGDST

General Description

Deck name:	WNGDST
Entry name:	WNGDST
Called by:	DATAIN
Subroutines called:	None

This subroutine calculates spanwise weight distributions of wing and contents and local weight moment of inertia for the distributed masses. Weight distributions are calculated for the wing weight, wing plus operational weight empty items, maximum design weight (MDW), basic flight design weight (BFDW), and landing design weight (LDW). All wing-contained items, with the exception of engine package-related items, are distributed by this routine. Methods used herein are described in Section II of this report.

Arrays and Variables Used

DVW	Calculated wing geometry data (refer to Table 37)
DVWT	Detail weight data and wing synthesis cut locations for wing in nominal position (refer to Table 38)
GDI(2)	Variable-sweep wing indicator 0 = fixed wing + = variable-sweep wing
GDW	Input wing geometry data (refer to Table 45)
GDWT	Input detail weight data (refer to Table 46)

Arrays and Variables Calculated

DWW	Wing and fixed contents distributed in weight distribution segments, lb
UX	Unit roll inertia of wing and contents about weight distribution segment centroid, lb-in.^{2}/lb
UY	Unit pitch inertia of wing and contents about weight distribution segment centroid, lb-in.^{2}/lb
UZ	Unit yaw inertia of wing and contents about weight distribution segment centroid, lb-in.^{2}/lb
WWT	Wing structure distributed in weight distribution segments, lb
WWT1	Wing and contents at MDW distributed in weight distribution segments, lb
WWT2	Wing and contents at BFDW distributed in weight distribution segments, lb
WWT3	Wing and contents at LDW distributed in weight distribution segments, lb
XBW1	X-centroid of wing and contents at MDW in weight distribution segments, wing in nominal position, in.
XBW2	X-centroid of wing and contents at BFDW in weight distribution segments, wing in nominal position, in.
XBW3	X-centroid of wing and contents at LDW in weight distribution segments, wing in nominal position, in.
XB10	X-centroid of wing structure in weight distribution segments, wing fixed or aft, in.
XB11	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.
XB12	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.
XB13	X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.
XB20	X-centroid of wing structure in weight distribution segments, wing fixed or fwd, in.
XB21	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.

XB22 X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.

XB23 X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.

XDW X-centroid of wing and fixed contents in weight distribution segments, wing in nominal position, in.

XDW1 X-centroid of wing and fixed contents in weight distribution segments, wing fixed or aft, in.

XDW2 X-centroid of wing and fixed contents in weight distribution segments, wing fixed or fwd, in.

YB10 Y-centroid of wing structure in weight distribution segments, wing fixed or aft, in.

YB11 Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.

YB12 Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.

YB13 Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.

YB20 Y-centroid of wing structure in weight distribution segments, wing fixed or fwd, in.

YB21 Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.

YB22 Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.

YB23 Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.

YDW1 Y-centroid of wing and fixed contents in weight distribution segments, wing fixed or aft, in.

YDW2 Y-centroid of wing and fixed contents in weight distribution segments, wing fixed or fwd, in.

YW Y-station of wing weight distribution cuts, wing in nominal position, in.

YY12 Pitch inertia of wing and contents at BFDW in weight distribution segments, wing fixed or aft, lb-in.^2

YY21 Pitch inertia of wing and contents at MDW in weight distribution segments, wing fixed or fwd, lb-in.^2

YY22 Pitch inertia of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, lb-in.^2

YY23 Pitch inertia of wing and contents at LDW in weight distribution segments, wing fixed or fwd, lb-in.^2

Scratch Arrays and Variables

CBW Average chord of wing weight distribution segments, in.
DYW Wing weight distribution segment lengths, in.
I Scratch counter
II Gross weight counter
  1 = MDW
  2 = BFDW
  3 = LDW
J Scratch counter
JJ Scratch counter
K Fuel tank counter
  1 = inboard tank
  2 = outboard tank
L Scratch counter
N Scratch counter
S Intermediate calculations (refer to Table 59)
XLW X-station of wing leading edge at weight distribution segment Y-centroids, wing in nominal position, in.
YBW Y-centroids of wing weight distribution segments, wing in nominal position, in.

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

ERROR INBD FUEL RIB IS OUTBD OF TIP

The foregoing message is printed when there is a fuel rib location error. Input data should be examined for errors.

TABLE 59. S-ARRAY VARIABLES IN SUBROUTINE WNGDST

Loc	Description
1	Intermediate calculations
•	
19	Intermediate calculations
20	Not used
21	Intermediate weight distribution of contents in weight distribution segment 1, lb
•	To
32	Intermediate weight distribution of contents in weight distribution segment 12, lb
33	Not used
•	
40	Not used
41	X-CG of intermediate weight distribution of contents in weight distribution segment 1, in.
•	
52	X-CG of intermediate weight distribution of contents in weight distribution segment 12, in.
53	Not used
•	
60	Not used
61	Weight distribution of wing payload in weight distribution segment 1, lb
72	Weight distribution of wing payload in weight distribution segment 12, lb
73	Not used
•	
80	Not used
81	X-CG of wing payload in weight distribution segment 1, in.
•	
92	X-CG of wing payload in weight distribution segment 12, in.

TABLE 59. S-ARRAY VARIABLES IN SUBROUTINE WNGDST (CONCL)

Loc	Distribution
93	Not used
•	
100	Not used
101	Relative volume of weight distribution segment 1
•	To
112	Relative volume of weight distribution segment 12
113	Not used
•	
120	Not used
121	Weight of fixed contents in weight distribution segment 1, lb
•	
132	Weight of fixed contents in weight distribution segment 12, lb
133	Not used
•	
140	Not used
141	X-CG of fixed contents in weight distribution segment 1, in.
•	
152	X-CG of fixed contents in weight distribution segment 12, in.
153	Not used
•	
160	Not used
161	XLW (1)
	To
172	XLW (12)

SUBROUTINE FUSDST

General Description

Deck name:	FUSDST
Entry name:	FUSDST
Called by:	DATAIN
Subroutines called:	DSTTRI

This routine distributes fuselage structural weight. One-half of the weight is distributed to the synthesis segments according to the ratio of the segment wetted area to the total wetted area. The center of gravity required for the second half of the weight is determined. Using this CG for the apex and total vehicle length as the base, a triangular distribution is obtained for half of the weight by using subroutine DSTTRI. The segment weights are the sums of these two distributions.

Arrays and Variables Used

DVWT(101)	Total fuselage structural weight, lb
DVWT(141)	CG of fuselage structural weight, in.
NC	Number of fuselage synthesis cuts input
SF	Array of segment wetted areas, $in.^2$
TOT(1)	Total wetted area
XBAR	Array of centroids of fuselage segments, in.
XI(1)	First geometry cut, tip of nose, in.
XI(10)	Last geometry cut, aft tip of fuselage, in.
XO	Array of synthesis cuts, in.

Arrays and Variables Calculated

Arguments for DSTTRI, in blank common:

I	Index, in fuselage synthesis array, of cut just forward of, or equal to, apex of triangular distribution
K	Index, in fuselage synthesis array, of last cut
L	Index, in fuselage synthesis array, of first cut
S(201)	Fuselage station of tip of nose, in.
S(202)	Length of forward section of base, in.
S(203)	Total length of base, [XI(10)-XI(1)], in.
S(214)	Station of CG of weight for triangular distribution, apex of triangle, in.
S(215)	Weight for triangular distribution, lb

Other calculated variables for general use:

WFUS Array of weight of fuselage structure in each segment

Scratch Array and Variables

I	Scratch index
J	Scratch index, NC+1
S(1)	Factor one-half total weight divided by total wetted area
S(2)	Summation of X-moments of weight distributed by wetted area
S(3)	Summation of weights distributed by wetted area
S(4)	Remaining weight to be distributed triangularly
S(5)	CG of weight to be distributed triangularly
S(221) through S(240)	Weights for each segment returned by DSTTRI

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

```
** FUSDST WARNING **
CHECK WT AND CG DATA
FUSELAGE WT DIST IS NOT REALISTIC
WT = x, CG = y
```

where

x is the total fuselage structural weight
y is the CG.

SUBROUTINE DSTTRI

General Description

Deck name:	DSTTRI
Entry name:	DSTTRI
Called by:	FUSDST
Subroutines called:	None

This routine calculates a triangular distribution for a given weight. The limits of the triangle are specified by index values in the fuselage synthesis system and by values given for the forward end, the base length, and the distance from the forward end to a perpendicular to the apex. Since the weights are placed at discreet points, specified by the XBAR array, the main triangular distribution may not have the required CG, so a correction triangle is calculated with its apex at the forward or aft end of the base of the main triangle.

Arrays and Variables Used

DELX	Array of fuselage segment lengths
I	Index of apex segment, forward section is from L to I
K	Index of last segment to which weight can be distributed
L	Index of first segment to which weight can be distributed
S(201)	Forward extent of triangle
S(202)	Length of forward part of base, from S(201) to CG of weight being distributed
S(203)	Total length of base
S(214)	CG of weight being distributed
S(215)	Weight to be distributed
XBAR	Array of centroids of fuselage segments

Arrays and Variables Calculated

S(J+220) through S(240)	Contain the distributed weights in the locations where J = L to J = K.

Scratch Arrays and Variables

J	Scratch counter and index
S(204)	Summation of area weighting factors from triangle with apex at CG of input weight
S(205)	Summation of area moments corresponding to areas in S(204)
S(206)	Summation of area weighting factors from correction triangle which has apex at fore or aft end, as required
S(207)	Summation of area moments corresponding to areas in S(206)
S(208)	Centroid of triangle with apex at CG of input weight
S(209)	Centroid of correction triangle
S(210)	Weight required for correction triangle
S(211)	Increment weight remaining for main triangle
S(212)	Weight factor for segments for main triangle
S(213)	Weight factor for segments for correction triangle
S(J+240)	Weighting factors for segment weights for main triangle (apex at CG of input weight)
S(J+260)	Weighting factors for segment weights for correction triangle

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE CONDST

General Description

Deck name: CONDST
Entry name: CONDST
Called by: DATAIN
Subroutines called: DSTNOR, DSTTRP

This routine distributes the fixed contents of the fuselage to the synthesis segments. The weights of these items are printed in the operational weight empty table produced by PRTOWE. In general, the weights are distributed by the routines DSTNOR and DSTTRP. Weights handled by DSTNOR are placed in the two fuselage segments nearest their CG's. Weights that are distributed by DSTTRP must have a fore and aft limit, and are divided between all the segments covered by those boundaries. For more detail and handling of special cases, refer to the descriptions of those subroutines.

One frequently used reference point is the furthest aft of the 25-percent elements of the mean aerodynamic chords of the major surfaces. This point will be referred to as the furthest aft surface $\bar{c}/4$.

Each time a weight is to be distributed by DSTRRP, a check is made to assure that the CG of the weight falls in the middle third of the length specified by the fore and aft limits. If it does not, the weight is distributed by DSTNOR and a warning message is printed giving the item name, its weight, and CG, and the limits that had been chosen for DSTTRP.

The distribution method used for each of the items considered is as follows:

- Main gear

  If the main gear is on the fuselage, its weight is distributed by DSTNOR.

- Nose gear

  The nose gear weight is distributed by DSTNOR.

- Surface controls

  If surface control weight is input, it is separated into two parts.

- Pilot controls, those in the cockpit, are distributed by DSTNOR.

- Surface controls that are between the cockpit and the various surfaces are distributed by DSTTRP. The forward limit is the CG of the pilot controls. The aft limit is the furthest aft surface $\bar{c}/4$.

• Other input structure

If a weight is input for other structure, it is distributed by DSTNOR.

• Fuel system

If there are fuel tanks in the fuselage, the weight of the fuselage fuel system is distributed by DSTTRP. The limits of the distribution are the extremes forward and aft of the five possible tanks.

• Engine controls

The weight of the engine controls is distributed by DSTTRP. The forward limit is the same cockpit point used for surface controls. The aft limit is the engine cg for fuselage-mounted nacelles or internal engines and the 25-percent element of the wing MAC for wing-mounted engines.

• Auxiliary power unit

The weight of this unit is distributed by DSTNOR.

• Instruments

The instrument weight in the fuselage is separated into two parts. Seven-tenths of the total instrument weight is assigned to the cockpit and distributed by DSTNOR.

The remainder of the fuselage instrument weight with the CG calculated for it is distributed by DSTTRP. The forward limit is the aforementioned cockpit CG, and the aft limit is the furthest aft surface $\bar{c}/4$.

• Hydraulic systems

The weight of hydraulic systems in the fuselage is distributed by DSTTRP. The forward limit is the CG, of pilot controls, and the aft limit is the furthest aft surface $\bar{c}/4$.

- Electrical systems

  The electrical system weight in the fuselage is distributed by DSTTRP. The forward limit is the CG, of pilot controls, and the aft limit is the furthest aft surface $\bar{c}/4$.

- Electronics

  If a weight is input for avionics in data location 814, it is distributed to one, two, or three compartments according to the data in locations 941, 942, and 943, the electronic compartment fuselage stations.

  - If all of the compartment locations are zero, the weight is distributed by DSTNOR about the fuselage station for avionics, data location 854.

  - If only one compartment location is given, the weight is distributed there by DSTNOR.

  - If the third compartment location is zero, the weight is distributed in two lumps, using DSTNOR for each. The fraction of the weight put in each compartment is proportional to the relative distance from the CG, to the other compartment.

  - If three compartment locations are given, one-half of the weight is given a CG, equal to the center compartment location (the factor 1/2 is in data location 222) and is distributed by DSTNOR. The CG of the remaining weight is determined, and the weight is then distributed in the manner described previously for two compartments.

- Armament

  If a weight is input for armament, a check is made to determine if a weight for guns is also input.

  - If guns are input, part of the armament weight is distributed by DSTNOR at the CG, for ammunition. This weight can be as much as 500 pounds, but is no more than 90 percent of the total armament weight. The CG, of the remaining armament weight is determined, and that weight is distributed by DSTTRP. The forward limit is the CG of the pilot controls, and the aft limit is an equal distance behind the CG of the weight.

- If no gun weight is input, the armament weight is distributed about its input X-station by DSTTRP. The forward limit is the location of pilot controls, and the aft limit is an equal distance behind the armament X-station.

- Furnishings

  If a weight is input for furnishings, it is distributed by DSTTRP. The forward limit is the location of the pilot controls. The aft limit changes with vehicle class. For class less than 30 (attack, fighters, and bombers), the limit is a distance behind the CG equal to the distance forward to the pilot controls. For class greater than 30 (both cargo and personnel transports), the aft limit is the input aft limit for fuselage payload (data location 892).

- Air conditioning

  If a weight is input for air conditioning, it is distributed by DSTTRP. The forward limit is the location of the pilot controls. The aft limit is the furthest aft surface $\bar{c}/4$, or the aft electronics compartment if it is further back.

If a weight is given for any of the following, it is distributed about its specified fuselage station by DSTNOR:

- Photographic equipment
- Auxiliary gear
- Other equipment
- Crew
- Trapped fuel
- Liquid nitrogen
- Miscellaneous
- Guns
- Pylons
- External tanks

If there are buried engines instead of nacelles, the weights of the engine and air induction system are distributed here.

- Engine section

  If there is an engine section weight, it is distributed by DSTNOR.

- Engine and exhaust system

  The engine and exhaust system weights are combined, the new CG is calculated, and the weight is distributed by DSTNOR.

- Accessories and gearboxes

  If there is a weight for this item, it is distributed by DSTNOR.

- Air induction system structure

  The weight of the air induction system is distributed by DSTTRP. The forward limit is the fuselage station of the duct leading edge. The aft limit is the fuselage station of the last duct cut (the engine face).

If weights are input for the following items to accompany buried engines, the weight is distributed by DSTNOR:

- Air induction system actuators and mechanisms
- Cooling system and drains
- Lubrication system
- Starting system
- Auxiliary power unit
- Instruments
- Hydraulic system
- Electrical system
- Air conditioning
- Oil

<u>Arrays and Variables Used</u>

D(1)	1.0 constant
D(2)	2.0 constant
D(3)	3.0 constant
D(10)	10.0 constant
D(24)	0.0 constant
DATD(NCD+10)	Inches from duct leading edge to last duct cut
DATS(1)	Number of nacelles per air vehicle, if zero indicates buried engines
DATA(13)	Fuselage station of duct leading edge
DVH(24)	25-percent element of mean aerodynamic chord of horizontal tail

DVV(24)	25-percent element of mean aerodynamic chord of vertical tail
DVW(43)	25-percent element of mean aerodynamic chord of wing
DVWT(21)	Total instrument weight
DVWT(60)	Fuselage station of engine CG
DVWT(93)	Fuselage station of CG of ammunition
DVWT	General weight and CG locations used (refer to Table 38)
EQU(136)	0.9, Fraction of armament weight to be placed at location of ammunition if total is 500 lb or less
EQU(138)	0.7, Fraction of total instrument weight to be placed at CG of pilot controls
EQU(142)	0.5, Fraction of total electronics equipment (avionics) to be placed in center compartment when three compartments are specified
EQU(143)	500.0, Pounds of armament weight to be placed at location of ammunition if there are guns on vehicle and armament weight is greater than 500 lb
GDI(1)	Vehicle class indicator used in furnishings
GDI(7)	Nacelle location indicator (0.0 = wing, 1.0 = fuselage) used in engine controlls
GDWT(102)	Fuselage station of aft limit of fuselage payload
GDWT(109)	Fuselage station of forward end of fuselage fuel tank 1
GDWT(110)	Fuselage station of aft end of fuselage fuel tank 1
GDWT(111)	Fuselage station of forward end of fuselage fuel tank 2
GDWT(112)	Fuselage station of aft end of fuselage fuel tank 2
GDWT(113)	Fuselage station of forward end of fuselage fuel tank 3
GDWT(114)	Fuselage station of aft end of fuselage fuel tank 3
GDWT(115)	Fuselage station of forward end of fuselage fuel tank 4
GDWT(116)	Fuselage station of aft end of fuselage fuel tank 4
GDWT(117)	Fuselage station of forward end of fuselage fuel tank 5
GDWT(118)	Fuselage station of aft end of fuselage fuel tank 5
GDWT(151)	Fuselage station of CG of forward electronics compartment
GDWT(152)	Fuselage station of CG of intermediate electronics compartment
GDWT(153)	Fuselage station of CG of aft electronics compartment
J	Index from distribution subroutine, forward segment for weight in work
K	Index from distribution subroutine, aft segment for weight in work
NCD	Number of geometry cuts through duct S(21)-S(40) used by distribution subroutines to transmit weights that have been distributed to segments. On return, weights are in S(20+J) through S(20+K). These are added into totals in DVWT(361) through DVWT(380)

Arrays and Variables Calculated

DWWT(361) through DWWT(380)	Weight per segment of fuselage operational weight empty items. Weights are summed in these locations throughout this routine.
S(1)	Weight of item transmitted to distribution subroutine
S(2)	CG of item transmitted to distribution subroutine
S(3)	Forward limit of distribution for DSTTRP
S(4)	Aft limit of distribution for DSTTRP

Scratch Arrays and Variables

I	Scratch index
II	Scratch index
S(5)	Miscellaneous
S(6)	Miscellaneous

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

```
***WARNING FROM CONDST***
PREVIOUS FORE AND AFT LIMITATIONS WERE a b
(item name) c LBS AT FUS. STA. d WERE DISTRIBUTED BY DSTNOR
```

where

a = forward limit set for DSTTRP for item
b = aft limit set for DSTTRP for item
c = weight of item named
d = CG for item named

SUBROUTINE DSTNOR

General Description

Deck name: DSTNOR
Entry name: DSTNOR
Called by: CONDST, DSTTRP, FTOTAL
Subroutines called: None

This routine distributes a point weight between two (or in special cases, three) fuselage stations. The division of the weight is proportional to the distance the point is from the other segment, XBAR. The width of the fuselage segments is available to this routine through common. If either of the wegments selected to receive the weight is 4 inches or less in width, the point weight is divided over three segments by going on to the segment beyond that narrow one. The amount of the weight placed in the narrow center segment is proportional to the width of that segment, compared to the total width of the three segments, and the point is shifted by a compensating distance. The remaining weight is distributed to the two outer segments by the inverse rule given previously.

Arrays and Variable Used

DELX	Array of widths of fuselage segments
NC	Number of fuselage synthesis cuts input; NC+1 is the number of segments
S(1)	Input point weight to be distributed
S(2)	Fuselage station of point weight
XBAR	Array of fuselage stations at centers of fuselage segments

Arrays and Variables Calculated

J	Index of forward segment to which weight is distributed
K	Index of aft segment to which weight is distributed

S(21) through S(40) array for distributed weight:

The weights are placed in two or three locations from S(J+20) to S(K+20) so the using routine can readily add them to weight arrays in use.

Scratch Arrays and Variables

N General index
WT Working location for point weight, either S(1) or S(1) minus weight calculated for narrow center segment.
CG Working location for input point, either S(2) or fuselage station of remaining weight shifted to compensate for a narrow center segment

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

*****IN DSTNR, WEIGHT w LB. LOCATED AT x IS FWD OF 1ST STA. y *****

where

w = Input point weight
x = fuselage station of input point
y = XBAR(1), center of first fuselage segment

*****IN DSTNOR, WEIGHT w LB. LOCATED AT x IS AFT OF LAST STA. y *****

where

w and x same as preceding
y = XBAR(NC+1), center of last fuselage segment

SUBROUTINE DSTTRP

General Description

Deck name: DSTTRP
Entry name: DSTTRP
Called by: FTOTAL, CONDST
Subroutines called: DSTNOR

This routine distributes a point weight over a specified fuselage length to a basic trapezoidal shape with a corrective crossing straight line shape to maintain the CG. The input arguments are weight, CG, and forward and aft extent of distribution. If the extent does not cover three or more fuselage segments, an error message is printed and DSTNOR is called to distribute the weight.

All variables referenced in this routine are in blank common.

Arrays and Variables Used

DELX	Array of fuselage segment lengths
NC	Number of fuselage synthesis cuts in input
S(1)	Weight to be distributed
S(2)	CG of input weight
S(3)	Forward extent of distribution
S(4)	Aft extent of distribution
XBAR	Array of centroids of fuselage segments
XO	Array of fuselage synthesis cuts

Arrays and Variables Calculated

J Index of forward fuselage segment to which weight was distributed
K Index of aft fuselage segment to which weight was distributed
S(J+20) through S(K+20) Array of calculated weights

Scratch Arrays and Variables

N	Scratch index and counter
NCL	Number of values in XO array, NC+1 and number of fuselage segments
S(5)	Summation of correction line weighting factors
S(6)	Summation of correction factor moments

S(7)	Summarion of trapezoidal weighting factors
S(8)	Summation of trapezoidal factor moments
S(9)	Total length over which weight is to be distributed
S(10)	One-half of S(9)
S(11)	Fuselage station of center of segments to which weight is to be distributed
S(12)	Calculated CG of trapezoid
S(13)	Weight to be distributed by correction line factors
S(14)	Weight to be distributed by trapezoidal factors
S(J+60) through S(K+60)	Correction line weighting factors
S(J+80) through S(K+80)	Trapezoidal weighting factors

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

```
*****IN DSTTRP, WEIGHT CANNOT BE DISTRIBUTED WT = w,
CG = c, FWD = f, AFT = a, RETURN J, K = j, k
```

where

w = Input weight value
c = Input CG value
f = Input forward extent value
a = Input aft extent value
j = Forward index value
k = Aft index value

SUBROUTINE FTOTAL

General Description

Deck name: FTOTAL
Entry name: FTOTAL
Called by: DATAIN
Subroutines called: DSTNOR, DSTTRP

This routine distributes the fuselage useful load for three gross weights: maximum design weight, basic flight design weight, and landing design weight. The subroutine DSTNOR and DSTTRP are called to perform the actual distribution of the load to the fuselage segments. Finally, fuselage contents per segment as calculated by CONDST are added to the load for each weight.

For those items which are to be distributed by DSTTRP, a check is made to insure that the CG of the load falls in the middle third of the distance between the fore and aft limits. If this condition is not met, the load is distributed by DSTNOR and a warning message is printed.

The method used to distribute each item is as follows:

- Fuselage payload

  For each gross weight if a fuselage payload exists, it is distributed by DSTTRP. The CG and the fore and aft limits are input locations 881, 891, and 892, respectively.

- Ammunition

  For each gross weight if there is a weight for ammunition, it is distributed by DSTNOR.

- Fuselage fuel

  Each fuselage tank weight is checked for each gross weight. When a tank weight is present, it is distributed between its fore and aft ends by DSTTRP.

Arrays and Variables Used

DVWT(361) thru DVWT(380)	Fuselage contents per segment calculated in CONDST
GDWT	For all items used from this array, refer to Table .
J	Index, returned by DSTNOR and STTRP, designating forward segment for item
K	Index, returned by DSTNOR and DSTTRP, designating aft segment for item
NC	Number of fuselage synthesis cuts
S(21) thru S(40)	Array used by DSTNOR and DSTTRP to return distributed weights. Weights for any items are in S(J+20) thru S(K+20).

Arrays and Variables Calculated

S(1) thru S(4)	Input arguments for DSTNOR and DSTTRP
WFC1(1) thru WFC1(20)	Useful load plus contents per fuselage segment for maximum design weight
WFC2(1) thru WFC2(20)	Useful load plus contents per fuselage segment for basic flight design weight
WFC3(1) thru WFC3(20)	Useful load plus contents per fuselage segment for landing design weight

Scratch Arrays and Variables

I,II,JJ	Scratch indexes
S(5)	One-third of distance between fore and aft limits set for DSTTRP, used for testing
S(41) thru S(60)	Per segment sum of useful load for each weight

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

```
***WARNING FROM FTOTAL***
PREVIOUS FORE AND AFT LIMITS WERE  a, b
item c LBS AT FUS. STA.  d DISTRIBUTED BY DSTNOR
```

where

a = forward limit
b = Aft limit
Item = Name of item for which DSTNOR is being used instead of DSTTRP
c = weight of item
d = CG of item

SUBROUTINE AVDATA

General Description

Deck name:	AVDATA
Entry name:	AVDATA
Called by:	DATAIN
Subroutines called:	AVDWNG, AVDAOC, AVDINR

This subroutine and AVDWNG, AVDAOC, and AVDONR calculate the vehicle weight, balance, and inertia which are required for vehicle load evaluation.

Subroutine AVDWNG is called to calculate wing and content weight, balance, and inertia.

Within this routine, the effects of fuselage and contents, horizontal tail and contents, vertical tail and contents, and nacelles and contents are calculated. Fuselage and content distributions, calculated in subroutines FUSDST, CONDST, and FTOTAL, are summarized to obtain weight, balance, pitch inertia, and yaw inertia at the different vehicle design weights.

Horizontal tail and content pitch and yaw inertias are calculated by the following approximations. The lateral centroid of the weight is assumed to be located outboard a distance one-third of the exposed semispan.

$$I_{YY} = \frac{W_H \, C_{SF}^2}{18}$$

$$I_{ZZ} = \frac{W_H \left(C_{SF}^2 + b_{exp}^2\right)}{18}$$

where

I_{YY} = pitch inertia about X-CG, lb-in.^{2}
W_H = weight of horizontal tail and contents, lb
C_{SF} = horizontal tail chord at side of fuselage, in.
I_{ZZ} = yaw inertia about X- and Y-CG, lb-in.^{2}
b_{exp} = exposed semispan, in.

Vertical tail and contents pitch and yaw calculations are similar. The vertical centroid is assumed to be a distance equal to one-third of the structure reference span.

$$I_{YY} = \frac{W_V \; C_{SF}^2 + b^2}{18}$$

$$I_{ZZ} = \frac{W_V \, C_{SF}^2}{18}$$

Where

C_{SF} = structure reference root chord, in.
b = structure reference span, in.
W_V = weight of vertical tail and contents, lb
I_{YY} = pitch inertia about X- and Z-CG, lb-in.^{2}
I_{ZZ} = yaw inertia about X-CG, lb-in.^{2}

Nacelle and contents weights are not distributed within this module. However, for the purpose of calculating inertia, the weight distribution is assumed to be proportional to the nacelle surface area. Pitch and yaw inertias are then calculated about the nacelle and content CG.

Subroutine AVDAOC combines the local inertia of the individual components to obtain the vehicle pitch and yaw inertia at the load evaluation conditions.

Subroutine AVDINR is called to organize the vehicle and individual component weight balance and inertia data in the proper order for use by the fuselage weight-estimating module.

Arrays and Variables Used

DATS	Input engine-related data (refer to Table 32)
DVH	Calculated horizontal tail geometry data (refer to Table 35)
DVV	Calculated vertical tail geometry data (refer to Table 36)
DVWT	Detail weight data (refer to Table 38)
GDH	Input horizontal tail geometry data (refer to Table 42)
GDW	Input wing geometry data (refer to Table 45)
ITP	Engine package type 0 = fuselage-buried engines 2 or 4 = number of nacelles
NC	Number of fuselage shell synthesis cuts
NCN	Number of nacelle cuts
SFN	Nacelle segment surface area, $in.^2$
UIY	Unit pitch inertia of fuselage and contents within segment about segment centroid, $lb\text{-}in.^2/lb$
UIYN	Unit pitch inertia of nacelle and contents within segment about segment centroid, $lb\text{-}in.^2/lb$
UIZ	Unit yaw inertia of fuselage and contents within segment about segment centroid, $lb\text{-}in.^2/lb$
UIZN	Unit yaw inertia of nacelle and contents within segment about segment centroid, $lb\text{-}in.^2/lb$
WFC1	Fuselage contents distribution at MDW in shell segments, lb
WFC2	Fuselage contents distribution at BFDW in shell segments, lb
WFC3	Fuselage contents distribution at LDW in shell segments, lb
WFUS	Fuselage structure distribution in shell segments, lb
XBAR	X-centroid of fuselage shell segments, in.
XBN	X-centroid of nacelle segments, in.
ZO	Z-coordinate of fuselage section centroid at synthesis cuts, in.

Arrays and Variables Calculated

DVWT	Detail weight data (refer to Table 38)
S	Intermediate calculations (refer to Table 60)

Scratch Arrays and Variables

I	Scratch counter
J	Scratch counter

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINES AVDATA, AVDWNG, AVDAOC, AND AVDINR

Loc	Description	Subroutine Reference
1	Sum of wing and contents weight at MDW, lb	AVDWNG, AVDATA, AVDAOC, AVDINR
2	Sum of X-moments of wing and contents at MDW, wing fixed or aft, in.-lb	AVDWNG, AVDATA
3	Sum of X-moments of wing and contents at MDW, wing fixed or fwd, in.-lb	AVDWNG, AVDATA
4	Sum of Y-moments of wing and contents at MDW, wing fixed or aft (all weight assumed to be concentrated in one panel), in.-lb	AVDWNG
5	Sum of Y-moments of wing and contents at MDW, wing fixed or fwd (all weight assumed to be concentrated in one panel), in.-lb	AVDWNG
6	Sum of wing and content weight at BFDW, lb	AVDWNG, AVDATA, AVDAOC, AVDINR
7	Sum of X-moments of wing and contents at BFDW, wing fixed or aft, in.-lb	AVDWNG, AVDATA
8	Sum of X-moments of wing and contents at BFDW, wing fixed or fwd, in.-lb	AVDWNG, AVDATA
9	Sum of Y-moments of wing and contents at BFDW, wing fixed or aft (all weight assumed to be concentrated in one panel), in.-lb	AVDWNG
10	Sum of Y-moments of wing and contents at BFDW, wing fixed or fwd (all weight assumed to be concentrated in one panel), in.-lb	AVDWNG
11	Sum of wing and content weight at LDW, lb	AVDWNG, AVDATA, AVDAOC, AVDINR
12	Sum of X-moments of wing and contents at LDW, wing fixed or aft, in.-lb	AVDWNG
13	Sum of X-moments of wing and contents at LDW, wing fixed or fwd, in.-lb	AVDWNG, AVDATA

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINES AVDATA, AVDWNG, AVDAOC, AND AVDINR (CONT)

Loc	Description	Subroutine Reference
14	Sum of Y-moments of wing and contents at LDW, wing fixed or aft (all weight assumed to be concentrated in one panel), in.-lb	AVDWNG
15	Sum of Y-moments of wing and contents at LDW, wing fixed or fwd (all weight assumed to be concentrated in one panel), in.-lb	AVDWNG
16	Pitch inertia of wing and contents at BFDW about wing and content X-CG, wing fixed or aft, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
17	Pitch inertia of wing and contents at BFDW about wing and content X-CG, wing fixed or fwd, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
18	Yaw inertia of wing and contents at BFDW about vehicle centerline and wing and content X-CG, wing fixed or aft, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
19	Yaw inertia of wing and contents at BFDW about vehicle centerline and wing and content X-CG, wing fixed or fwd, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
20	X-CG of wing and contents at MDW, wing fixed or aft, in.	AVDWNG
21	X-CG of wing and contents at MDW, wing fixed or fwd, in.	AVDWNG, AVDAOC, AVDINR
22	Y-CG of wing and contents (per panel) at MDW, wing fixed or aft, in.	AVDWNG
23	Y-CG of wing and contents (per panel) at MDW, wing fixed or fwd, in.	AVDWNG, AVDINR
24	X-CG of wing and contents at BFDW, wing fixed or aft, in.	AVDWNG, AVDAOC, AVDINR
25	X-CG of wing and contents at BFDW, wing fixed or fwd, in.	AVDWNG, AVDAOC, AVDINR

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINES AVDATA, AVDWNG, AVDAOC, AND AVDINR (CONT)

Loc	Description	Subroutine Reference
26	Y-CG of wing and contents (per panel) at BFDW, wing fixed or aft, in.	AVDWNG, AVDINR
27	Y-CG of wing and contents (per panel) at BFDW, wing fixed or fwd, in.	AVDWNG, AVDINR
28	X-CG of wing and contents at LDW, wing fixed or aft, in.	AVDWNG
29	X-CG of wing and contents at LDW, wing fixed or fwd, in.	AVDWNG, AVDAOC, AVDINR
30	Y-CG of wing and contents (per panel) at LDW, wing fixed or aft, in.	AVDWNG
31	Y-CG of wing and contents (per panel) at LDW, wing fixed or aft, in.	AVDWNG, AVDINR
32	Sum of fuselage and contents weight at MDW, lb	AVDATA
33	Sum of X-moments of fuselage and contents at MDW, in.-lb	AVDATA
34	Sum of fuselage and contents weight at BFDW, lb	AVDATA
35	Sum of X-moments of fuselage and contents at BFDW, in.-lb	AVDATA
36	Sum of fuselage and contents weight at LDW, lb	AVDATA
37	Sum of X-moments of fuselage and tents at LDW, in.-lb	AVDATA
38	X-CG of fuselage and contents at MDW, in.	AVDATA
39	X-CG of fuselage and contents at BFDW, in.	AVDATA
40	X-CG of fuselage and contents at LDW, in.	AVDATA
41	Sum of horizontal tail and contents weight, lb	AVDATA, AVDAOC, AVDINR
42	X-CG of horizontal tail and contents, in.	AVDATA, AVDAOC, AVDINR
43	Y-CG of horizontal tail and contents (per panel), in.	AVDATA, AVDAOC, AVDINR

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINE AVDATA, AVDWNG, AVDAOC, AND AVDINR (CONT)

Loc	Description	Subroutine Reference
44	Pitch inertia of horizontal tail and contents about horizontal tail and contents X-CG, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
45	Yaw inertia of horizontal tail and contents about panel Y-CG and horizontal tail and content X-CG, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
46	Sum of vertical tail and contents weight, lb	AVDATA, AVDAOC, AVDINR
47	X-CG of vertical tail and contents, in.	AVDATA, AVDAOC, AVDINR
48	Z-CG of vertical tail and contents, in.	AVDATA, AVDAOC, AVDINR
49	Pitch inertia of vertical tail and contents about vertical tail and contents X- and Z-CG's, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
50	Yaw inertia of vertical tail and contents about panel Y-CG, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
51	Sum of inboard nacelle and contents weight, lb	AVDATA, AVDAOC, AVDINR
52	Sum of X-moments of inboard nacelle and contents, in.-lb	AVDATA, AVDINR
53	X-CG of inboard nacelle and contents	AVDATA, AVDAOC, AVDINR
54	Y-CG of inboard nacelle and contents	AVDATA, AVDAOC, AVDINR
55	Pitch inertia of inboard nacelle and contents about nacelle and contents X-CG, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
56	Yaw inertia of inboard nacelle and contents about nacelle and contents X- and Y-CG's, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
57	Sum of outboard nacelle and contents weight, lb	AVDATA, AVDAOC, AVDINR
58	Sum of X-moments of outboard nacelle and contents, in.-lb	AVDATA, AVDINR
59	X-CG of outboard nacelle and contents, in.	AVDATA, AVDAOC, AVDINR

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINES AVDATA, AVDWNG, AVDAOC, AND AVDINR (CONT)

Loc	Description	Subroutine Reference
60	Y-CG of outboard nacelle and contents, in.	AVDATA, AVDAOC, AVDINR
61	Pitch inertia of outboard nacelle and contents about nacelle and contents X-CG, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
62	Yaw inertia of outboard nacelle and contents about nacelle and contents X- and Y-CG's, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
63	Total surface area of one nacelle, $in.^2$	AVDATA
64	Total vehicle MDW, lb	AVDATA, AVDINR
65	Sum of X-moments of all components at MDW, wing fixed or aft, in.-lb	AVDATA
66	Sum of X-moments of all components at MDW, wing fixed or fwd, in.-lb	AVDATA
67	Vehicle X-CG at MDW, wing fixed or aft, in.	AVDATA
68	Vehicle X-CG at MDW, wing fixed or fwd, in.	AVDATA, AVDAOC, AVDINR
69	Total vehicle BFDW, lb	AVDATA, AVDINR
70	Sum of X-moments of all components at BFDW, wing fixed or aft, in.-lb	AVDATA
71	Sum of X-moments of all components at BFDW, wing fixed or fwd, in.-lb	AVDATA
72	Vehicle X-CG at BFDW, wing fixed or aft, in.	AVDATA, AVDAOC, AVDINR
73	Vehicle X-CG at BFDW, wing fixed or fwd, in.	AVDATA, AVDAOC, AVDINR
74	Vehicle pitch inertia at BFDW, wing fixed or aft, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
75	Vehicle pitch inertia at BFDW, wing fixed or fwd, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
76	Vehicle yaw inertia at BFDW, wing fixed or aft, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR
77	Vehicle yaw inertia at BFDW, wing fixed or fwd, $lb\text{-}in.^2$	AVDATA, AVDAOC, AVDINR

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINES AVDATA, AVDWNG, AVDAOC, AND AVDINR (CONT)

Loc	Description	Subroutine Reference
78	Sum of pitch inertia about individual component CG of horizontal tail, vertical tail, inboard nacelles, and outboard nacelles, lb-in.^{2}	AVDAOC
79	Sum of yaw inertia about individual component CG of horizontal tail, vertical tail, inboard nacelles, and outboard nacelles, lb-in.^{2}	AVDAOC
80	Total vehicle LDW, lb	AVDATA, AVDINR
81	Sum of X-moments of all components at LDW, wing fixed or fwd, in.-lb	AVDATA
82	Vehicle X-CG at LDW, wing fixed or fwd, in.	AVDATA, AVDAOC, AVDINR
83	Sum of Z-moments of fuselage and contents at MDW, in.-lb	AVDATA
84	Sum of Z-moments of fuselage and contents at BFDW, in.-lb	AVDATA
85	Sum of Z-moments of fuselage and contents at LDW, in.-lb	AVDATA
86	Z-CG of fuselage and contents at MDW, in.	AVDATA
87	Z-CG of fuselage and contents at BFDW, in.	AVDATA
88	Z-CG of fuselage and contents at LDW, in.	AVDATA
89	Pitch inertia of wing and contents at MDW about wing and content X-CG, wing fixed or fwd, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
90	Pitch inertia of wing and contents at LDW about wing and content X-CG, wing fixed or fwd, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
91	Yaw inertia of wing and contents at MDW about vehicle centerline and wing and content X-CG, wing fixed or fwd, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR

TABLE 60. S-ARRAY VARIABLES IN SUBROUTINES AVDATA, AVDWNG, AVDAOC, AND AVDINR (CONCL)

Loc	Description	Subroutine Reference
92	Yaw inertia of wing and contents at LDW about vehicle centerline and wing and content X-CG, wing fixed or fwd, lb-in.^{2}	AVDWNG, AVDAOC, AVDINR
93	Vehicle pitch inertia at MDW, wing fixed or fwd, lb-in.^{2}	AVDATA, AVDAOC, AVDINR
94	Vehicle pitch inertia at LDW, wing fixed pr fwd, lb-in.^{2}	AVDATA, AVDAOC, AVDINR
95	Vehicle yaw inertia at MDW, wing fixed or fwd, lb-in.^{2}	AVDATA, AVDAOC, AVDINR
96	Vehicle yaw inertia at LDW, wing fixed or fwd, lb-in.^{2}	AVDATA, AVDAOC, AVDINR
97	Sum of Z-moments of all components at MDW, in.-lb	AVDATA
98	Vehicle Z-CG at MDW, in.	AVDATA, AVDAOC, AVDINR
99	Sum of Z-moments of all components at BFDW, in.-lb	AVDATA
100	Vehicle X-CG at BFDW, in.	AVDATA, AVDAOC, AVDINR
101	Sum of Z-moments of all components at LDW, in.-lb (also intermediate calculation)	AVDATA
102	Vehicle Z-CG at LDW, in. (also intermediate calculation)	AVDATA, AVDAOC, AVDINR
103	Intermediate calculation	AVDATA
104	Not used	
.		
109	Not used	
110	Intermediate calculations	AVDAOC, AVDINR
.		
127	Intermediate calculations	AVDAOC, AVDINR
128	Not used	
.		
190	Not used	
191	Intermediate storage	AVDINR
.		
400	Intermediate storage	AVDINR

Labeled Common Arrays

IP(48) Print/no-print indicator
- 0 = print intermediate calculation variables in S-array (see figure 34)
- 1 = no print

Mass Storage File Records

None

Error Messages

None

SUBROUTINE AVDWNG

General Description

Deck name;	AVDWNG
Entry name:	AVDWNG
Callded by:	AVDATA
Subroutines called:	None

This subroutine summarizes the wing and contents weight, CG, and inertia at the different load evaluation conditions. These calculations are performed by summing the effects of the wing and contents distributed by subroutine WNGDST.

Pitch and yaw inertia about the wing and content CG are calculated for the following vehicle loadings:

1. Basic flight design weight (BFDW) with the wing in the forward and aft sweep positions

2. Maximum design weight (MDW) with the wing in the forward sweep position

3. Landing design weight (LDW) with the wing in the forward sweep position

The foregoing reference to wing sweep position is relevant to variable sweep wing vehicles.

S(I) FROM AVDATA ** AVDATA - IP(48) **

1	154057.0581	146087135.2632	146087135.2632	58911174.3560	58911174.3560
6	152157.0505	144456928.7424	144456928.7424	58528106.8416	58528106.8416
11	93557.0564	90211460.7061	90211460.7061	37738314.8903	37738314.8903
16	2244567933.4391	2244567933.4391	33582023446.8015	33582023446.8015	948.2664
21	948.2664	382.3984	382.3984	949.3936	949.3936
26	384.6559	384.6559	964.2400	964.2400	403.3722
31	403.3722	124063.4504	111525079.7947	124063.4504	111525079.7947
36	124063.4504	111525079.7947	898.9358	898.9358	898.9358
41	4554.6304	1846.8453	100.6933	7148039.4048	30238048.1104
46	2572.9036	1749.9266	376.8851	21287722.2711	10661506.7937
51	16375.9825	12070501.7895	737.0857	285.0000	57868111.9310
56	57868111.9310	16375.9825	13527964.2339	826.0857	460.0000
61	57864111.9310	57869111.9310	39915.2736	318000.0076	296124771.5208
66	296124771.5208	931.2100	931.2100	316100.0000	294494565.0000
71	294494565.0000	931.6500	931.6500	23285348948.9281	23285348948.9281
76	58452727891.8137	58452727891.8137	1441719885.5378	1566357778.7661	257500.0060
81	240249096.9637	933.0062	25838375.8126	25838375.8126	25838375.8126
86	208.2674	208.2674	208.2474	2270347320.0393	1381925591.9468
91	33695791734.8013	22263157326.7754	22307991058.0784	22386372337.7302	55098864305.4387
96	47184451804.2092	79298646.9766	249.3668	78759044.8182	249.1586
101	62116646.5108	241.2297	100.5233	0.0000	0.0000
106	0.0000	0.0000	0.0000	0.0000	32751.9650

Figure 34. Sample output of S-array variables from subroutines AVDATA, AVDWNG, AVDAOC, and AVDINR.

Arrays and Variables Used

UZ	Unit yaw inertia of wing and conent about weight distribution segment centroid, lb-in.^{2}/lb
WWT1	Wing and contents at MDW distributed in weight distribution segments, lb
WWT2	Wing and contents at BFDW distributed in weight distribution segments, lb
WWT3	Wing and contents at LDW distributed in weight distribution segments, lb
XB11	X-centroid of wing and contents of MDW in weight distribution segments, wing fixed or aft, in.
XB12	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.
XB13	X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.
XB21	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.
XB22	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.
XB23	X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.
YB11	Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.
YB12	Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.
YB13	Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.
YB21	Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.
YB22	Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.
YB23	Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.
YY12	Pitch inertia of wing and contents at BFDW in weight distribution segments, wing fixed or aft, lb-in.^{2}
YY21	Pitch inertia of wing and contents at MDW in weight distribution segments, wing fixed or fwd, lb-in.^{2}
YY22	Pitch inertia of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, lb-in.^{2}
YY23	Pitch inertial of wing and contents at LDW in weight distribution segments, wing fixed or fwd, lb-in.^{2}

Arrays and Variables Calculated

S Intermediate calculations (refer to Table 60)

Scratch Arrays and Variables

I Scratch counter

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE AVDAOC

General Description

Deck name:	AVDAOC
Entry name:	AVDAOC
Called by:	AVDATA
Subroutines called:	None

This subroutine combines the inertias of wing and contents, horizontal tail and contents, vertical tail and contents, and nacelle and contents with the fuselage and content inertias to obtain vehicle pitch and yaw inertias. Vehicle inertias are calculated for the following vehicle loadings:

1. Basic flight design weight (BFDW) with the wing in the forward and and aft sweep positions

2. Maximum design weight (MDW) with the wing in the forward sweep position

3. Landing design weight (LDW) with the wing in the forward sweep position

Arrays and Variables Used

DATS	Input engine related data (refer to Table 32)
GDH	Input horizontal tail geometry data (refer to Table 42)
GDV	Input vertical tail geometry data (refer to Table 44)
GDW	Input wing geometry data (refer to Table 45)
S	Intermediate calculations (refer to Table 60)

Arrays and Variables Calculated

S	Intermediate calculations (refer to Table 60)

Scratch Arrays and Variables

N	Scratch counter
W	X-CG of wing and contents, in.
X	Vehicle X-CG, in.
XAH	Horizontal tail and contents X-transfer to vehicle X-CG, in.^{2}
XANI	Inboard nacelles and contents X-transfer to vehicle X-CG, in.^{2}
XANO	Outboard nacelles and contents X-transfer to vehicle X-CG, in.^{2}
XAV	Vertical tail and contents X-transfer to vehicle X-CG, in.^{2}
XAW	Wing and contents X-transfer to vehicle X-CG, in.^{2}
YAH	Horizontal tail and contents Y-transfer to vehicle centerline, in.^{2}
YANI	Inboard nacelle and contents Y-transfer to vehicle centerline, in.^{2}
YANO	Outboard nacelle and contents Y-transfer to vehicle centerline, in.^{2}
YAV	Vertical tail and contents Y-transfer to vehicle centerline, in.^{2}
Z	Vehicle Z-CG, in.
ZAH	Horizontal tail and contents Z-transfer to vehicle Z-CG, in.^{2}
ZANI	Inboard nacelle and contents Z-transfer to vehicle Z-CG, in.^{2}
ZANO	Outboard nacelle and contents Z-transfer to vehicle Z-CG, in.^{2}
ZAV	Vertical tail and contents Z-transfer to vehicle Z-CG, in.^{2}
ZAW	Wing and contents Z-transfer to vehicle Z-CG, in.^{2}

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE AVDINR

General Description

Deck name: AVDINR
Entry name: AVDINR
Called by: AVDATA
Subroutines called: None

This subroutine organizes the vehicle and individual component weight, balance, and inertia data in the FUSDWI array and writes these data in record 34 for use by the fuselage weight-estimating module. Data are arranged to correspond with the airloads and inertia factors which are calculated by the airloads module. In addition, limit speed profile data are also stored in the FUSDWI array for use in evaluating local panel flutter.

Should the vertical tail be on the wing, vertical tail and content weight and inertia are included with the total wing and contents. Nacelles, should they exist, are mounted either on the fuselage or on the wing. Should the nacelles be mounted on the wing, their weights and inertias are also included with the wing and contents. These distinctions are made to account for inertia reactions by the fuselage. Although horizontal tails may be mounted on the vertical tail, the weight and inertia data are defined separately. The combination of the two and the net inertia effects are calculated in the fuselage weight-estimating module.

Arrays and Variables Used

ALT	Altitude points on speed-altitude profile with wing fixed or aft, ft
DATS	Engine section and air induction system data (refer to Table 32)
GDH(11)	Z-station of horizontal tail reference plane, in.
GDI(7)	Nacelle location indicator 0 = wing mounted + = fuselage mounted
GDV(7)	Buttock line of vertical tail root, in. 0 = single vertical tail + = dual vertical tail Y-station

GDV(30)	Vertical tail location indicator 0 = fuselage mounted 1 = wing mounted
GDW(11)	Z-station of wing reference plane, in.
QL	Dynamic pressure on limit speed profile, lb/ft^2
S	Intermediate calculations (refer to Table 60)
VL	Limit speed at speed profile altitudes, M
WFC1	Fuselage contents distribution at MDW in shell segments, lb
WFC2	Fuselage contents distribution at BFDW in shell segments, lb
WFC3	Fuselage contents distribution at LDW in shell segments, lb
WFUS	Fuselage structure distribution in shell segments, lb

Arrays and Variables Calculated

FUSDWI	Vehicle weight, balance, inertia, and limit speed profile data (refer to Table 61)

Scratch Arrays and Variables

I	Scratch counter
M	Scratch counter
N	Scratch counter
RA	Weight balance and inertia data for fuselage-mounted nacelle package
RH	Weight balance and inertia data for horizontal tail and contents
RO	Weight, balance, and inertia for other external fuselage-mounted item (currently inactive)
RT	Total vehicle weight balance and inertia data
RV	Weight, balance, and inertia data for vertical tail and contents
RW	Weight, balance, and inertia data of wing and contents
S(116) - S(127)	Nacelle-related intermediate calculations
VYCG	Y-station of vertical tail, in.
WT	Weight, lb
XCG	X-CG intermediate calculation, in.
YCG	Y-CG intermediate calculation, in.
ZCG	Z-CG intermediate calculation, in.

TABLE 61. FUSDWI ARRAY VARIABLES

Location	Description
Locations 1 through 90 contain weight and inertia data at basic flight design weight for wing aft or for fixed wing	
1	Basic flight design weight (BFDW), lb
2	X-CG at BFDW, in.
3	Not used
4	Z-CG at BFDW, in.
5	Not used
6	Pitch, inertia at BFDW, lb-in.^{2}
7	Yaw inertia at BFDW, lb-in.^{2}
8	Wing and content weight, lb
9	X-CG wing and contents, in.
10	Y-CG wing and contents per side, in.
11	Z-CG wing and contents, in.
12	Not used
13	Pitch inertia, wing and contents, lb-in.^{2}
14	Yaw inertia, wing and contents, lb-in.^{2}
15	Horizontal tail and contents weight, lb
16	X-CG horizontal tail and contents, in.
17	Y-CG horizontal tail and contents per side, in.
18	Z-CG horizontal tail and contents, in.
19	Not used
20	Pitch inertia horizontal tail and contents, lb-in.^{2}
21	Yaw inertia horizontal tail and contents, lb-in.^{2}
22	Vertical tail and contents weight, lb
23	X-CG vertical tail and contents, in.
24	Y-CG vertical tail and contents per panel, in.
25	Z-CG vertical tail and contents, in.
26	Not used
27	Pitch inertia vertical tail and contents, lb-in.^{2}
28	Yaw inertia vertical tail and contents, lb-in.^{2}
30	Nacelle and contents weight, lb
31	X-CG nacelle and contents, in.
32	Y-CG nacelle and contents per side, in.
33	Z-CG nacelle and contents, in.
34	Not used
35	Pitch inertia nacelle and contents, lb-in.^{2}
36	Yaw inertia nacelle and contents, lb-in.^{2}
37-42	Not used (fuselage-mounted external store data)
43-50	Not used

TABLE 61. FUSDWI ARRAY VARIABLES (CONCL)

Location	Description
51-70	Weight of fuselage contents distributed in synthesis segments, lb
71-90	Weight of fuselage distributed in synthesis segments, lb
91-180	Weight and inertia data at basic flight design weight for wing forward. Data are organized in same sequence as noted for locations 1 through 90.
181-270	Weight and inertia data at maximum design weight (MDW) for wing fixed or forward. Data are organized in same sequence as noted for locations 1 through 90.
271-360	Weight and inertia data at landing design weight (LDW) for wing fixed or forward. Data are organized in same sequence as noted for locations 1 thorugh 90.
361-450	Weight and inertia data at maximum design weight (MDW) for wing fixed or forward. Data are organized in same sequence as noted for locations 1 through 90.
451-460	Altitudes on speed-altitude profile with wing aft, ft
461-470	Mach numbers on speed-altitude profile, M
471-480	Dynamic pressures on speed-altitude profile, lb/ft^2

Labeled Common Arrays

IP(45) Print/no-print indicator
- 0 = print weight, balance, and inertia data for total vehicle and for individual fuselage-mounted components (see Figure 35)
- 1 = no print

Mass Storage File Records

Record 34 Write FUSDWI array

Error Messages

None

SUBROUTINE DBLCNT

General Description

Deck name:	DBLCNT
Entry name:	DBLCNT
Called by:	DATAIN
Subroutines called:	None

This routine sets up vehicle data in the BC array for use by the airloads module. The values have all been calculated elsewhere and, except for a change in units in a few values, are directly transferred to the BC array here.

Arrays and Variables Used

ALT(1) thru ALT(9)	Altitudes of the speed-altitude profile for wing fixed or aft. The first and two others are used, depending on GDI(19) and GDI(20).
DATM(33) thru DATM(35)	Altitudes for speed-altitude points for wing forward, ft
DATM(36) thru DATM(38)	Limit mach numbers that correspond to preceding three altitudes
DVH(1) thru DVH(22)	Horizontal tail geometry items (refer to Table 35)

CHECK PRINT FOR AVDINW

** AVDINW - TOTAL **

WT	.316100E+06	.316100E+06	.318800E+06	.257500E+06	.318800E+06
	.931655E+03	.931655E+03	.931210E+03	.933006E+03	.931210E+03
	0.	0.	0.	0.	0.
	.269159E+03	.269159E+03	.269367E+03	.261230E+03	.269367E+03
	0.	0.	0.	0.	0.
	.232853E+11	.232853E+11	.233088E+11	.223806E+11	.233088E+11
	.586527E+11	.586527E+11	.550989E+11	.471849E+11	.550989E+11
WB	.186909E+06	.186909E+06	.188809E+06	.126309E+06	.188803E+06
	.919671E+03	.919671E+03	.919063E+03	.916078E+03	.919063E+03
	.382503E+03	.382503E+03	.380093E+03	.395367E+03	.380093E+03
	.267194E+03	.267194E+03	.267364E+03	.250790E+03	.267364E+03
	0.	0.	0.	0.	0.
	.362715E+10	.362715E+10	.366096E+10	.250071E+10	.366436E+10
	.393188E+11	.393188E+11	.394221E+11	.290485E+11	.394221E+11
WM	.455463E+06	.455463E+06	.455463E+06	.455463E+06	.455463E+06
	.186685E+06	.186685E+06	.186685E+06	.186685E+06	.186685E+06
	.100693E+03	.100693E+03	.100693E+03	.100693E+03	.100693E+03
	.558660E+03	.558660E+03	.558660E+03	.558660E+03	.558660E+03
	0.	0.	0.	0.	0.
	.716806E+07	.716806E+07	.716806E+07	.716806E+07	.716806E+07
	.766181E+08	.766181E+08	.766181E+08	.766181E+08	.766181E+08
WV	.257290E+06	.257290E+06	.257290E+06	.257290E+06	.257290E+06
	.174993E+06	.174993E+06	.174993E+06	.174093E+06	.174993E+06
	0.	0.	0.	0.	0.
	.376885E+03	.376885E+03	.376885E+03	.376095E+03	.376885E+03
	0.	0.	0.	0.	0.
	.212877E+08	.212877E+08	.212877E+08	.212077E+08	.212877E+08
	.106615E+08	.106615E+08	.106615E+08	.106615E+08	.106615E+08
WA	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
WO	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.

Figure 35. Sample output of total vehicle and individual fuselage-mounted component weight, balance, and inertia.

DVV(1) thru DVV(21), DVV(26)	Vertical tail geometry items (refer to Table 36)
DVW(1) thru DVW(41)	Wing geometry items (refer to Table 37)
DVWT(944)	Maximum design weight (MDW), lb
DVWT(945)	X-CG at MDW, wing fixed or aft, in.
DVWT(946)	X-CG at MDW, wing fixed or forward, in.
DVWT(951)	Basic flight design weight (BFDW), lb
DVWT(952)	X-CG at BFDW, wing fixed or aft, in.
DVWT(953)	X-CG at BFDW, wing fixed or forward, in.
DVWT(957)	Pitch inertia at BFDW, fixed or aft, $lb\text{-}in.^2$
DVWT(958)	Pitch inertia at BFDW, fixed or forward, $lb\text{-}in.^2$
DVWT(959)	Yaw inertia at BFDW, fixed or aft, $lb\text{-}in.^2$
DVWT(960)	Yaw inertia at BFDW, fixed or forward, $lb\text{-}in.^2$
DVWT(961)	Landing design weight (LDW), lb
DVWT(963)	X-CG at LDW, fixed or forward, in.
GDD(11) thru GDD(18)	Load factor, speed, and acceleration item (refer to Table 41)
GDI(16)	Wing lift carry-over reduction factor
GDI(17)	Horizontal tail lift carry-over reduction factor
GDI(18)	Vertical tail lift carry-over reduction factor
GDI(19), GDI(20)	Speed profile points for flight load investigation; if either or both zero, use point 3 and/or 4.
GDW(37)	Y-station of flap inboard end, in.
GDW(38)	Y-station of flap outboard end, in.
GDW(39)	Ratio of flap chord to total chord
GDW(40)	Maximum flap deflection, deg
VH(1) thru VH(9)	Maximum level-flight speeds at altitudes (ALT), first and two others used, mach
VL(1) thru VL(9)	Limit speeds at altitudes (ALT), first and two others used, mach

Arrays and Variables Calculated

For BC array items set up, refer to Table 26. The locations referencing this routine are 1 through 168, except 33 through 36; they are placed in BC here.

Scratch Arrays and Variables

I,J,K   Index and calculated subscript use

Labeled Common Arrays

None

Mass Storage File Records

None

Error Messages

None

SUBROUTINE DWHVQQ

General Description

Deck name:	DWHVQQ
Entry name:	DWHVQQ
Called by:	DATAIN
Subroutines called:	None

This routine sets up speed-altitude data and horizontal tail weight and inertia data for use in subroutine WHVQQ in the flutter and temperature module. Record number 38 is read into the SPAL array, the data values are transferred into the array, and the record is rewritten.

Arrays and Variables Used

ALT(1) thru ALT(9)	Altitude points on speed-altitude profile for wing fixed or aft, ft
D(34)	Flutter speed margin
DATM(33) thru DATM(35)	Altitudes for speed-altitude profile for wing forward, for variable-sweep wing vehicles only, ft
DATM(36) thru DATM(38)	Limit speeds to correspond to the three preceding altitudes, mach
DVWT(968)	Weight of horizontal tail and contents, lb
DVWT(969)	X-CG of horizontal tail and contents, in.
DVWT(970)	Y-CG of horizontal tail and contents, in.
DVWT(972)	Pitch inertia of horizontal tail and contents, lb-in.^{2}
DVWT(973)	Yaw inertia of horizontal tail and contents, lb-in.^{2}
GDH(10)	Dihedral angle of horizontal tail, deg

GDH(11)	Z-station of horizontal tail reference plane, in.
GDI(2)	Variable-sweep wing indicator 0 = fixed + = variable
VL(1) thru VL(9)	Limit speeds for altitudes in array ALI, mach

Arrays and Variables Calculated

SPAL(1)	Horizontal tail and contents weight per side, lb
SPAL(2)	Y-CG horizontal tail and contents per side, in.
SPAL(3)	X-CG horizontal tail and contents, in.
SPAL(4)	Z-CG horizontal tail and contents, in.
SPAL(5)	Pitch inertia horizontal tail and contents, lb-in.^{2}
SPAL(6)	0.0 (roll inertia of horizontal tail and contents)
SPAL(7)	Yaw inertia horizontal tail and contents, lb-in.^{2}
SPAL(12)	Dihedral angle of horizontal tail, deg
SPAL(16)	Flutter speed margin
SPAL(17) thru SPAL(25)	Altitudes for speed profile for wing fixed or aft, ft
SPAL(26) thru SPAL(34)	Mach numbers for the nine preceding altitudes
SPAL(35) thru SPAL(37)	Altitudes for speed profile for wing forward, ft
SPAL(38) thru SPAL(40)	Mach numbers for the three preceding altitudes

Scratch Arrays and Variables

I Indexing

Labeled Common Arrays

None

Mass Storage File Records

Record 38 is read into and rewritten from the SPAL array.

Error Messages

None

SUBROUTINE DCCNTL

General Description

Deck name:	DCCNTL
Entry name:	DCCNTL
Called by:	DATAIN
Subroutines called:	None

This subroutine organizes wing, horizontal tail, and vertical tail geometry data in the WD array for use by the wing and empennage module. The WD array is written on mass storage file record 21. Estimated structure weight, contents, and nacelle, and store weight and balance data are also written on record 21.

Arrays and Variables Used

DATS	Input engine-related data (refer to Table 32)
DSP(5)	Maximum dynamic pressure on limit speed flight profile, lb/ft^2
DVH	Calculated horizontal tail geometry data (refer to Table 35)
DVV	Calculated vertical tail geometry data (refer to Table 36)
DVW	Calculated wing geometry data (refer to Table 37)
DVWT	Detail weight data and wing synthesis cut locations for wing in nominal position (refer to Table 38)
GDD	Vehicle design data (refer to Table 41)
GDH	Input horizontal tail geometry data (refer to Table 42)
GDI	Vehicle design indicators (refer to Table 43)
GDV	Input vertical tail geometry data (refer to Table 44)
GDW	Input wing geometry data (refer to Table 45)
GDWT	Input detail weight data (refer to Table 46)

Arrays and Variables Calculated

WD	Wing, horizontal tail, and vertical tail geometry and design data (refer to Table 50)

Scratch Arrays and Variables

I	Scratch counter
S(201)	Half of X-distance between inboard store CG and outboard store CG, in.

Labeled Common Arrays

IP(47)	Print/no-print indicator 0 = print complete W/D array (see Figure 36) 1 = no print
XMISC(53)	Vertical-tail-type indicator -1 = single tail 0 = dual tail +1 = T-type tail

Mass Storage File Records

Record 21 Write WD array

Error Messages

None

SUBROUTINE DFATMG

General Description

Deck name:	DFATMG
Entry name:	DFATMG
Called by:	DATAIN
Subroutines called:	None

This routine calculates and organizes data that are required by the airloads module in the calculation of fatigue spectra. Wing inertia bending moments per unit load factor versus vehicle weight are calculated for two wing stations. Unswept moments are calculated for the inboard fatigue evaluation station, wing synthesis cut 1, and swept moments are calculated at the outboard station, synthesis cut 2. These bending moments are calculated at wing loadings which correspond to maximum design weight (MDW), basic flight design weight (BFDW), and vehicle weight with zero expendable useful load. These vehicle weights are calculated as ratios of vehicle weight to fatigue evaluation taxi weight. These data, together with input fatigue life data, are stored in the BC array.

Inertia bending moments at the flight load evaluation conditions are stored in the XMISC array. These data provide correlation between flight design loads and fatigue spectra loads in the airloads module.

*D(I) FROM DCCNIL ** DCCNTL - TP(47) **

1	0.0000	314000.0076	316100.0000	2.5000	-1.0000
6	533.2874	.3775	0.0000	.0506	0.0000
11	0.0000	0.0000	0.0000	648.7600	3002.8300
16	8.5197	28.1090	.4175	155.4000	.0304
21	862.0628	56.1000	1.0000	2.0000	77.7000
26	165.8988	254.0976	342.2364	430.4952	518.6940
31	606.8928	695.0916	783.2904	871.4892	937.6383
36	33820.0000	32869.9962	858.0000	78.0000	325.0000
41	24520.0000	24520.0000	1047.3600	415.0000	948.0000
46	8187.9913	285.0000	737.0857	-91.2900	1.0000
51	28934055.9655	0.0000	28934055.9655	8187.9913	40.0000
56	626.0857	-98.4800	1.0000	28934055.9655	[illegible].0000
61	28934055.9655	0.0000	0.0000	0.0000	0.0000
66	0.0000	0.0000	0.0000	0.0000	0.0000
71	0.0000	0.0000	0.0000	0.0000	0.0000
76	0.0000	0.0000	0.0000	0.0000	0.0000
81	0.0000	0.0000	0.0000	0.0000	0.0000
86	0.0000	0.0000	0.0000	0.0000	0.0000
91	0.0000	0.0000	0.0000	0.0000	0.0000
96	0.0000	0.0000	0.0000	0.0000	0.0000
101	0.0000	0.0000	116680.0000	1900.0076	0.0000
106	2.5000	0.0000	0.0000	0.0000	0.0000
111	.4000	0.0000	.0058	1718.1700	483.0000
116	5.2480	28.9845	.3609	0.0000	443.9948
121	0.0000	2.0000	0.0000	30.2080	60.4160
126	90.6239	120.8319	151.0309	181.2479	211.4559
131	241.6639	271.8718	294.5278	.4000	.2500
136	.0069	1544.8000	832.0000	2.4820	35.0000
141	.6089	0.0000	491.8639	0.0000	2.0000
146	0.0000	27.2655	54.5310	81.7966	109.0621
151	136.3276	163.5931	190.8586	218.1242	245.3897
156	265.8388	1.0000	1.0000	0.0000	284.0000
161	.1633	.6125	0.0000	558.6600	.1050
166	1.0000	0.0000	286.0000	.1300	1.0000
171	0.0000	0.0000	0.0000	0.0000	0.0000
176	0.0000	0.0000	0.0000	0.0000	0.0000
181	0.0000	0.0000	0.0000	0.0000	0.0000
186	0.0000	0.0000	0.0000	0.0000	0.0000
191	0.0000	0.0000	0.0000	0.0000	0.0000
196	0.0000	0.0000	0.0000	0.0000	0.0000

Figure 36. Sample output of WD array variables.

Arrays and Variables Used

BC(1)	Maximum design weight, lb
BC(10)	Vehicle yaw inertia with wing fixed on aft at basic flight design weight, slug-ft^2
BC(11)	Landing design weight, lb
DATS(1)	Number of nacelles on vehicle
DATS(14)	Y-station of inboard nacelle centerline at engine front face, in.
DATS(17)	Y-station of outboard nacelle centerline at engine front face, in.
DVW(3)	Sweep of elastic axis for wing fixed or aft, deg
DVW(23)	Sweep of elastic axis for wing forward, deg
DVWT(1) thru DVWT(40)	Structural and operational weight empty items summed for minimum weight, lb
DVWT(974)	Inboard nacelle and content weight, lb
DVWT(975)	X-station of inboard nacelle CG
DVWT(979)	Outboard nacelle and content weight, lb
DVWT(980)	X-station of outboard nacelle CG
DWW(2) thru DWW(12)	Wing plus contents distribution for minimum flying weight (OWE)
GDD(7)	Air vehicle service life, hours
GDD(8)	Number of landings during service life
GDD(9)	Taxi gross weight for fatigue if different from landing design weight
GDD(10)	Landing gross weight for fatigue if different from landing design weight
WWT1(2) thru WWT1(12)	Wing plus contents distribution for maximum design weight (MDW)
WWT2(2) thru WWT2(12)	Wing plus contents distribution for basic flight design weight (BFDW)
WWT3(2) thru WWT3(12)	Wing plus contents distribution for landing design weight (LDW)
XB11(2) thru XB11(12)	X-stations of CG of distributed wing plus contents for wing fixed or aft at MDW
XB12(2) thru XB12(12)	X-stations of CG of distributed wing plus contents for wing fixed or aft at BFDW
XB13(2) thru XB13(12)	X-stations of CG of distributed wing plus contents for wing fixed or aft at LDW
XB21(2) thru XB21(12)	X-stations of CG of distributed wing plus contents for wing forward at MDW
XB22(2) thru XB22(12)	X-stations of CG of distributed wing plus contents for wing forward at BFDW
XB23(2) thru XB23(12)	X-stations of CG of distributed wing plus contents for wing forward at LDW

XDW1(2) thru XDW1(12)	X-stations of CG of distributed wing plus contents for wing fixed or aft at OWE
XDW2(2) thru XDW2(12)	X-stations of CG of distributed wing plus contents for wing forward at OWE
XEA1	X-station of wing outboard station with wing fixed or aft
XEA2	X-station of wing outboard station with wing forward
YB11(2) thru YB11(12)	Butt planes of CG of distributed wing plus contents for wing fixed or aft at MDW
YB12(2) thru YB12(12)	Butt planes of CG of distributed wing plus contents for wing fixed or aft at BFDW
YB13(2) thru YB13(12)	Butt planes of CG of distributed wing plus contents for wing fixed or aft at LDW
YB21(2) thru YB21(12)	Butt planes of CG of distributed wing plus contents for wing forward at MDW
YB22(2) thru YB22(12)	Butt planes of CG of distributed wing plus contents for wing forward at BFDW
YB23(2) thru YB23(12)	Butt planes of CG of distributed wing plus contents for wing forward at LDW
YDW1(2) thru YDW1(12)	Butt planes of CG of distributed wing plus contents for wing fixed or aft at OWE
YDW2(2) thru YDW2(12)	Butt planes of CG of distributed wing plus contents for wing forward at OWE
YEA1	Butt plane of wing outboard station with wing fixed or aft
YEA2	Butt plane of wing outboard station with wing forward
YSF	Butt plane of side of fuselage

Arrays and Variables Calculated

BC(169)	Air vehicle service life
BC(170)	Number of landings during service life
BC(171)	Unswept wing outboard station for fatigue evaluation
BC(172)	Weight ratio 1, for which inertia moment is calculated
BC(173)	Weight ratio 2, for which inertia moment is calculated
BC(174)	Weight ratio 3, for which inertia moment is calculated

BC(175) thru BC(177)	Unswept moment at side of body per unit load factor, at each weight ratio, for wing fixed or aft
BC(178) thru BC(180)	Swept moment at outboard station per unit load factor, at each weight ratio, for wing fixed or aft
BC(181) thru BC(183)	Unswept moment at side of body per unit load factor, at each weight ratio, for wing forward (variable sweep only)
BC(184) thru BC(186)	Swept moment at outboard station per unit load factor, at each weight ratio, for wing forward (variable sweep only)
BC(187)	Takeoff weight for fatigue
BC(188)	Landing weight for fatigue

Scratch Arrays and Variables

S(1) thru S(5)	Miscellaneous temporary values
S(104) thru S(106)	Unswept moment at side of body per unit load factor, for wing fixed or aft, for MDW, BFDW, LDW
S(107) thru S(109)	Swept moment at outboard station per unit load factor, for wing fixed or aft, for MDW, BFDW, LDW
S(110 thru S(112)	Unswept moment at side of body per unit load factor, for wing forward, for MDW, BFDW, LDW
S(113) thru S(115)	Swept moment at outboard station per unit load factor, for wing forward, for MDW, BFDW, LDW
S(116)	Inboard nacelle weight, working location
S(117)	X-station of inboard nacelle CG, working location
S(118)	Y-station of inboard nacelle CG, working location
S(119)	Outboard nacelle weight or zero
S(120)	X-station of outboard nacelle CG or zero
S(121)	Y-station of outboard nacelle CG or zero
S(122)	Unswept moment at side of body per unit load factor, for wing fixed or aft, for OWE
S(123)	Swept moment at outboard station per unit load factor, for wing fixed or aft, for OWE
S(124)	Unswept moment at side of body per unit load factor, for wing forward, for OWE
S(125)	Swept moment at outboard station per unit load factor, for wing forward, for OWE

Labeled Common Arrays

In block MISC, the following items are set up:

XMISC(34)	Air vehicle service life
XMISC(43)	Unswept moment at side of body per unit load factor, for wing fixed or aft, for BFDW
XMISC(44)	Swept moment at outboard station per unit load factor, for wing fixed or aft, for BFDW
XMISC(45) thru XMISC(47)	Unswept moment at side of body per unit load factor, for wing fixed or forward, for MDW, BFDW, LDW
XMISC(48) thru XMISC(50)	Swept moment at outboard station, per unit load factor, for wing fixed or forward, for MDW, BFDW, LDW

Mass Storage File Records

None

Error Message

None

SUBROUTINE DMAXLD

General Description

Deck name: DMAXLD
Entry name: DMAXLD
Called by: DATAIN
Subroutines called: None

This subroutine calculates 1 g inertia shear, bending moment, and torque at the wing, horizontal tail, and vertical tail weight analysis cuts. These loads are defined in the swept structural elastic axis system.

Wing weight distributions, calculated by subroutine WNGDST, are used to calculate wing inertia loads. Horizontal tail and contents and vertical tail and contents are distributed on the respective surfaces by using a parabolic-shaped spanwise distribution. The equations and methods are identical to those used to distribute wing structure weight.

In addition, net wing taxi loads are calculated. Should the main landing gear be on the wing, gear reactions are included in the net load computation.

The 1 g inertia loads and net wing taxi loads are written from the WLD array into mass storage file record 18. This record is used in the airloads module to calculate net surface loads.

Arrays and Variables Used

DATS	Input engine-related data (refer to Table 32)
DVH	Calculated horizontal tail geometry data (refer to Table 35)
DVV	Calculated vertical tail geometry data (refer to Table 36)
DVW	Calculated wing geometry data (refer to Table 37)
DVWT	Detail weight data (refer to Table 38)
GDD	Vehicle design data (refer to Table 41)
GDI	Vehicle design indicators (refer to Table 43)
WWT	Wing structure distributed in weight distribution segments, lb
WWT1	Wing and contents at MDW distributed in weight distribution segments, lb
WWT2	Wing and contents at BFDW distributed in weight distribution segments, lb
WWT3	Wing and contents at LDW distributed in weight distribution segments, lb
XB10	X-centroid of wing structure in weight distribution segments, wing fixed or aft, in.
XB11	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.
XB12	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.
SB13	X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.
XB20	X-centroid of wing structure in weight distribution segments, wing fixed or fwd, in.
XB21	X-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.
XB22	X-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.
XB23	X-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.
YB10	Y-centroid of wing structure in weight distribution segments, wing fixed or aft, in.

YB11 Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or aft, in.
YB12 Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or aft, in.
YB13 Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or aft, in.
YB20 Y-centroid of wing structure in weight distribution segments, wing fixed or fwd, in.
YB21 Y-centroid of wing and contents at MDW in weight distribution segments, wing fixed or fwd, in.
YB22 Y-centroid of wing and contents at BFDW in weight distribution segments, wing fixed or fwd, in.
YB23 Y-centroid of wing and contents at LDW in weight distribution segments, wing fixed or fwd, in.

Arrays and Variables Calculated

WLD 1 g inertial and wing net taxi loads data (refer to Table 51). The following variables are subsets of this array:
BMH, BMV, BMW1, BMW2, BM12, BM2G, BM21, BM22, BM23, TH, TV, TW1, TW2, T12, T2G, T21, T22, T23, VH, VV, VW1, VW2, V12, V2G, V21, V22, V23
HWT Horizontal tail and contents distributed in weight distribution segments, lb
VWT Vertical tail and contents distributed in weight distribution segments, lb
XBH X-centroid of horizontal tail and contents in weight distribution segments, in.
XBV X-centroid of vertical tail and contents in weight distribution segments, in.
YBH Y-centroid of vertical tail and contents in weight distribution segments, in.
ZBV Z-centroid of vertical tail and contents in weight distribution segments, in.

Scratch Arrays and Variables

CBH Average chord of horizontal tail weight distribution segments, in.
CBV Average chord of vertical tail weight distribution segments, in.
S Intermediate calculations

XEAH X-station of horizontal tail elastic axis at weight distribution cuts, in.

XEAV X-station of vertical tail elastic axis at weight distribution cuts, in.

XLH X-station of horizontal tail leading edge at weight distribution segment Y-centroids, in.

XLV X-station of vertical tail leading edge at weight distribution segment Z-centroids, in.

YEAH Y-station of horizontal tail elastic axis at weight distribution cuts, in.

ZEAV Z-station of vertical tail elastic axis at weight distribution cuts, in.

Labeled Common Arrays

IP(47) Print/no-print indicator
0 = print details from WLD array (see Figures 37, 38, and 39)
1 = no print

Mass Storage File Records

Record 18 written from WLD array.

Error Messages

None

SUBROUTINE DLNDGR

General Description

Deck name: DLNDGR
Entry name: DLNDGR
Called by: DATAIN
Subroutines called: None

This routine is called only if the takeoff gross weight in the landing gear data is negative or zero. When this routine is entered, it reads the landing gear data record and initializes some of the items with values input to or calculated by this module. The record is then rewritten.

SHEAR, MOMENT AND TORQUE ** DMAXLD - TP(47) **

	WING ONLY AT 1G				WING AND CONTENTS AT 1G			
	AFT POSITION				AFT POSITION GROSS WEIGHT 2			
I	SHEAR	MOMENT	TORQUE	BUTT PLANE	SHEAR	MOMENT	TORQUE	I
1	-14095.	-5691116.	436652.	77.7	-90231.	-30098413.	-2235126.	1
2	-12035.	-4385150.	356572.	165.9	-75287.	-22037602.	-2283464.	2
3	-10086.	-3277929.	285205.	254.1	-62090.	-15344440.	-2329732.	3
4	-8255.	-2358166.	222283.	342.3	-42351.	-10930680.	-1160238.	4
5	-6551.	-1613850.	167538.	430.5	-40360.	-6884239.	-1224186.	5
6	-4983.	-1032073.	120707.	518.7	-23594.	-4455085.	-42260.	6
7	-3566.	-598802.	81539.	606.9	-16374.	-2522869.	-23079.	7
8	-2316.	-298507.	49815.	695.1	-10422.	-1226612.	-11985.	8
9	-1261.	-113533.	25397.	783.3	-5661.	-448236.	-6032.	9
10	-446.	-22804.	8372.	871.5	-2034.	-76195.	-2319.	10
11	-56.	-1134.	992.	937.6	-65.	-1325.	1159.	11

	WING ONLY AT 1G				WING AND CONTENTS AT 1G			
	FORWARD POSITION				FORWARD POSITION AT GROSS WEIGHT 1			
I	SHEAR	MOMENT	TORQUE	BUTT PLANE	SHEAR	MOMENT	TORQUE	I
1	-14095.	-5691116.	436652.	77.7	-91181.	-30226556.	-2238372.	1
2	-12035.	-4385150.	356572.	165.9	-75875.	-22091670.	-2285404.	2
3	-10086.	-3277929.	285205.	254.1	-62362.	-15357252.	-2330599.	3
4	-8255.	-2358166.	222283.	342.3	-42351.	-10930680.	-1160238.	4
5	-6551.	-1613850.	167538.	430.5	-40360.	-6884239.	-1224186.	5
6	-4983.	-1032073.	120707.	518.7	-23594.	-4455085.	-42260.	6
7	-3566.	-598802.	81539.	606.9	-16374.	-2522869.	-23079.	7
8	-2316.	-298507.	49815.	695.1	-10422.	-1226612.	-11985.	8
9	-1261.	-113533.	25397.	783.3	-5661.	-448236.	-6032.	9
10	-446.	-22804.	8372.	871.5	-2034.	-76195.	-2319.	10
11	-56.	-1134.	992.	937.6	-65.	-1325.	1159.	11

Figure 37. Sample output of wing 1 g inertia loads and net taxi loads.

** DMAXL) - IP(47) **

WING AND CONTENTS AT 1G

FORWARD POSITION AT GROSS WEIGHT 2

I	SHEAR	MOMENT	TORQUE	BUTT PLANE
1	-90231.	-30098413.	-2235126.	77.7
2	-75287.	-22037602.	-2283464.	165.9
3	-62090.	-15344440.	-2329732.	254.1
4	-42351.	-10930680.	-1160238.	342.3
5	-40360.	-6884239.	-1224186.	430.5
6	-23594.	-4455085.	-42260.	518.7
7	-16374.	-2522869.	-23079.	606.9
8	-10422.	-1226612.	-11985.	695.1
9	-5461.	-448236.	-6032.	783.3
10	-2034.	-76195.	-2319.	871.5
11	-65.	-1325.	1159.	937.6

WING AND CONTENTS AT 1G

FORWARD POSITION AT GROSS WEIGHT 3

SHEAR	MOMENT	TORQUE	I
-60931.	-21240507.	-2056140.	1
-53147.	-15664985.	-2130368.	2
-46225.	-10806807.	-2197881.	3
-31876.	-7664368.	-1045577.	4
-29885.	-4635376.	-1109525.	5
-16002.	-3066905.	36029.	6
-11158.	-1743918.	27470.	7
-7126.	-851566.	17994.	8
-3872.	-313605.	9219.	9
-1308.	-55024.	2850.	10
-65.	-1325.	1159.	11

NET WING LOADS AT 2G TAXI

FORWARD POSITION AT GROSS WEIGHT 1

I	SHEAR	MOMENT	TORQUE	BUTT PLANE
1	-182363.	-60453111.	-4476744.	77.7
2	-151750.	-44183340.	-4570808.	165.9
3	-124725.	-30714504.	-4661198.	254.1
4	-84702.	-21861340.	-2320476.	342.3
5	-80721.	-13768478.	-2448372.	430.5
6	-47188.	-8910171.	-84520.	518.7
7	-32768.	-5045737.	-46158.	606.9
8	-20845.	-2453223.	-23971.	695.1
9	-11323.	-804472.	-12063.	783.3
10	-4069.	-152390.	-4638.	871.5
11	-130.	-2649.	2317.	937.6

Figure 37. Sample output of wing 1 g inertia loads and net taxi loads (concl).

VERTICAL TAIL AND CONTENTS

** DMAXLD - IP(47) **

COORD. OF E. A. Z	X	SHEAR	MOMENT	TORQUE
0.00	1654.04			
0.00	1654.04	-2573.	-369962.	55779.
27.27	1671.53	-2197.	-284629.	46707.
54.53	1689.02	-1841.	-215708.	37687.
81.80	1706.51	-1507.	-156513.	29935.
109.06	1724.00	-1196.	-108312.	23032.
136.33	1741.49	-910.	-70323.	16970.
163.59	1758.98	-651.	-41698.	11749.
190.86	1776.47	-423.	-21502.	7374.
218.12	1793.96	-230.	-8683.	3873.
245.39	1811.45	-81.	-2000.	1320.
265.84	1824.56	-10.	-144.	141.
272.66	1828.94			

SECTION WEIGHT	COORDINATES Z BAR	X BAR
.00	0.00	1684.59
376.12	13.63	1692.74
355.76	40.90	1709.03
334.17	68.16	1725.33
311.07	95.43	1741.62
286.12	122.69	1757.92
258.76	149.96	1774.21
228.13	177.23	1790.51
192.64	204.49	1806.80
148.77	231.76	1823.10
71.19	255.61	1837.35
10.17	269.25	1845.50

Figure 38. Sample output of horizontal tail 1 g inertia loads.

HORIZONTAL TAIL AND CONTENTS

** DMAXLD - IP(47) **

COORD. OF E. A. Y	COORD. OF E. A. X	SHEAR	MOMENT	TORQUE
0.00	1785.40			
0.00	1785.40	-2277.	-309383.	23850.
30.21	1797.90	-1944.	-237507.	19331.
60.42	1810.40	-1630.	-177436.	15336.
90.62	1822.89	-1334.	-127556.	11844.
120.83	1835.39	-1058.	-87210.	8837.
151.04	1847.89	-805.	-55698.	6294.
181.25	1860.39	-576.	-32252.	4197.
211.46	1872.88	-374.	-16028.	2526.
241.66	1885.38	-204.	-6060.	1266.
271.87	1897.88	-72.	-1199.	409.
294.53	1907.25	-9.	-57.	48.
302.06	1910.38			

SECTION WEIGHT	COORDINATES Y BAR	COORDINATES X BAR
.00	0.00	1800.57
665.82	15.10	1806.34
629.78	45.31	1817.88
591.55	75.52	1829.42
550.67	105.73	1840.96
506.50	135.94	1852.50
458.06	166.14	1864.05
403.84	196.35	1875.59
341.02	226.56	1887.13
263.35	256.77	1898.67
126.03	283.20	1908.77
18.00	298.30	1914.54

Figure 39. Sample output of vertical tail 1 g inertia loads.

Arrays and Variables Used

DVWT(944)	Maximum design weight (MDW), lb
DVWT(946)	X-station if vehicle CG at MDW with wing fixed or forward, in.
DVWT(947)	Z-station of vehicle CG at MDW, in.
DVWT(961)	Landing design weight (LDW), lb
DVWT(963)	X-station of vehicle CG at LDW with wing fixed or foward, in.
GDD(18)	Minimum speed with flaps down at LDW, knots
GDD(19)	Design sink speed at MDW, ft/sec
GDD(20)	Design sink speed at LDW, ft/sec
GDD(21)	Main landing gear stroke, fully extended to fully compressed, in.
GDD(22)	Nose landing gear stroke, fully extended to fully compressed, in.
GDD(23)	Main landing gear length with oleo extended, axle to trunnion centerline, in.
GDD(24)	Nose landing gear length with oleo extended, axle to trunnion centerline, in.
GDD(26)	X-station of center of main gear axle in extended position, in.
GDD(27)	X-station of center of nose gear axle in extended position, in.
GDD(28)	Z-station of ground line at main gear, in.
GDD(29)	Y-station of center of main gear axle in extended position, in.

This routine must be the last one of this module because the landing gear data are read into the first part of common where data constants are stored for the other routines.

Arrays and Variables Calculated

The landing gear data are in the D-array. The items set up here follow.

D(46)	Maximum design weight (MDW)
D(47)	Landing design weight (LDW)
D(48)	0.0, aborted takeoff weight increment
D(49)	X-station of vehicle CG at MDW with wing fixed or in forward position
D(50)	X-station of vehicle CG at LDW with wing fixed or in forward position

D(51) Z-distance from vehicle CG, to ground at MDW at main gear
D(52) X-station of center of main gear axle in extended position
D(53) X-station of center of nose gear axle in extended position
D(54) Y-distance between main gear in extended position, center to center
D(72) Main gear length with oleo extended, axle to trunnion centerline
D(73) Main gear stroke, fully extended to fully compressed
D(81) Nose gear length with oleo extended, axle to trunnion centerline
D(83) Nose gear stroke, fully extended to fully compressed
D(89) Design sink speed at MDW
D(90) Design sink speed at LDW
D(91) Landing speed at MDW, ft/sec
D(92) Landing speed at LDW, ft/sec

Scratch Arrays and Variables

None

Labeled Common Arrays

None

Mass Storage Files

Reads and writes record 25, the landing gear module input data record.

Error Messages

None

Section IV

REFERENCES

1. United States Committee on Extension of the Standard Atmosphere, U.S. Standard Atmosphere, 1962, Library of Congress Catalog No. 551, U.S. Government Printing Office, Washington, D.C., December 1962

2. MIL-E-5008C, "Engines, Aircraft, Turbojets, and Turbofan, Model Specification For" (Outline and Instructions for Preparation)

3. Yount, L.C., "Hammershock Status Survey," TFD-71-1486, North American Rockwell Corporation, Los Angeles, 1971

4. Crosthwait, E. L., Kennon, I. G. Jr., and Roland, H. L., "Preliminary Design Methodology For Air-Induction Systems," SEG-TR-67-1, Air Force Systems Command, WPAFB, Ohio, 1967